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NATIONAL DAM SAFETY PROGRAM. NEVERSINK RESERVOIR DAM, (348), DE--ETC(U)
SEP 78 J B STETSON DACW51-78-C-0035

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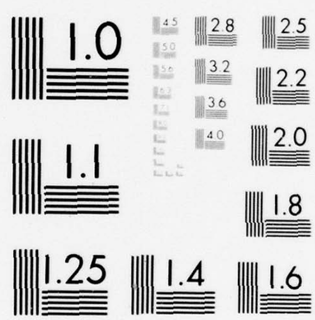

MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

DELWARE RIVER BASIN

NEVERSINK RESERVOIR DAM
SULLIVAN COUNTY NEW YORK
INVENTORY № 348

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

NEW YORK DISTRICT CORPS OF ENGINEERS

AUGUST 1978

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

Neversink Reservoir Dam was judged to be safe.

LEVEL II

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam Neversink Dam & Reservoir NY348

State Located	New York
County Located	Sullivan
Stream	Neversink River
Date of Inspection	July 21, 1978

ASSESSMENT OF GENERAL CONDITIONS

The Neversink Dam is an earthen dam with a concrete cutoff wall. The cutoff wall is founded on rock and the foundation is grouted. The dam has been in operation since 1953 and has received continual maintenance by the City of New York, owner of the structure. This investigation has found nothing to deem the dam unsafe. The visual inspection encountered a number of maintenance items which should be performed. The embankment has a large number of animal holes which should be filled and seeded to prevent surface erosion. The owner should consider retaining the grassed embankment and to continue mowing rather than planting crown vetch which easily conceals seepage, minor sloughing and surface cracks should they occur. Some deterioration of the spillway concrete has occurred which should be repaired. Exposed shale along the western upstream abutment should be protected from erosion. An analysis of the dam's spillway indicates the structure is capable of passing a Probable Maximum Flood.

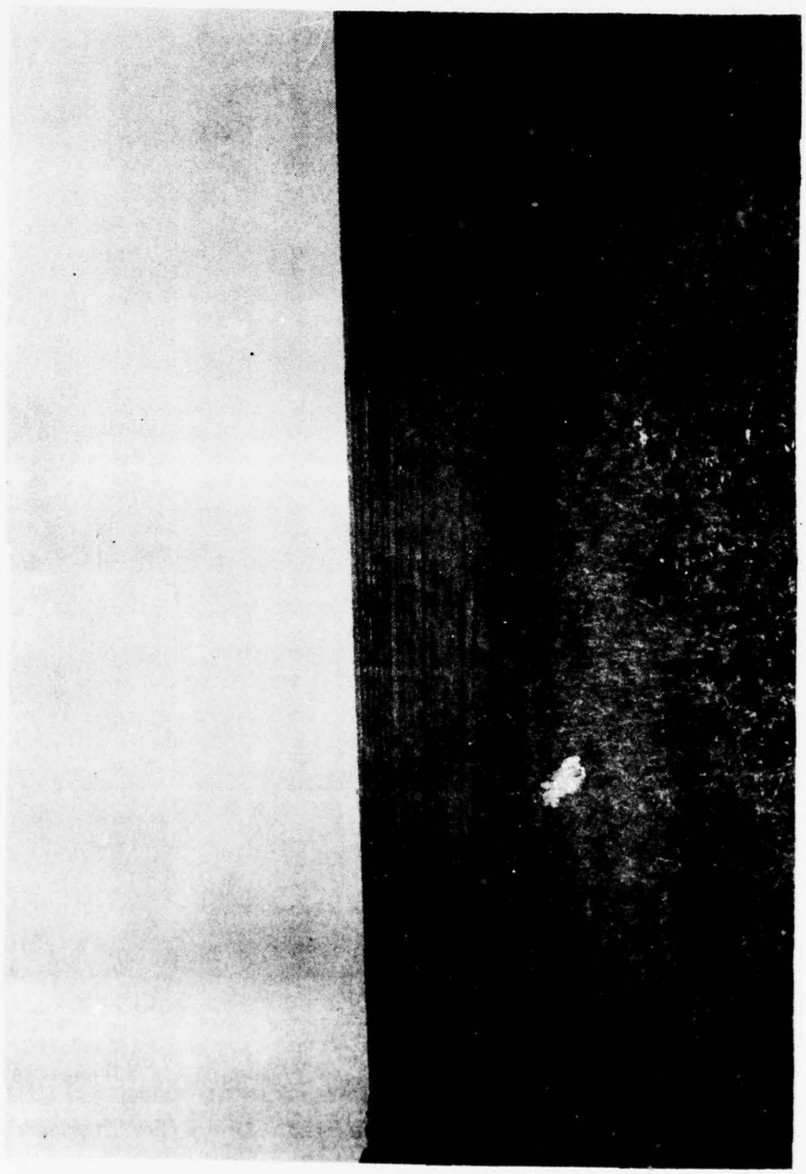
STATE OF NEW YORK
DALE ENGINEERING COMPANY, INCORPORATED
NO.
LICENSED PROFESSIONAL ENGINEER

Dale Engineering Company

John B. Stetson, President

Approved By:
Date: 18 September 1978

Col. Clark H. Benn
New York District Engineer



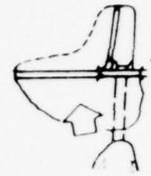
Overview of Neversink Dam Embankment.

1. View east along downstream side of the top of dam.

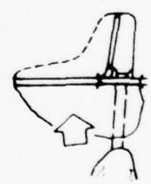
2. View of downstream embankment from same location.

3. View of upstream embankment and riprap.

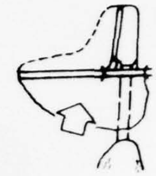
4. View of right upstream embankment near abutment.



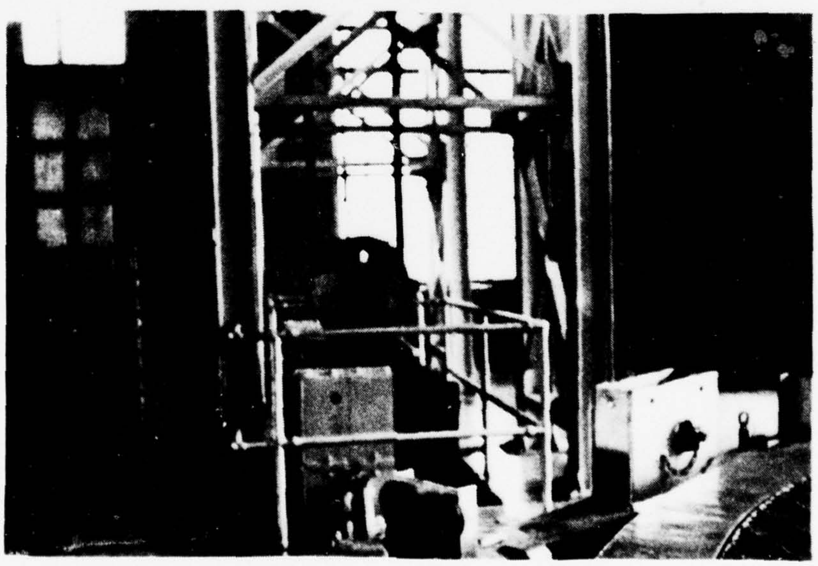
5. View of downstream embankment from below dam. In left center of picture is a small shed which remains after construction.

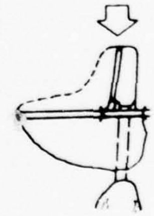


6. Typical woodchuck hole in downstream embankment (estimate 100 holes in embankment).

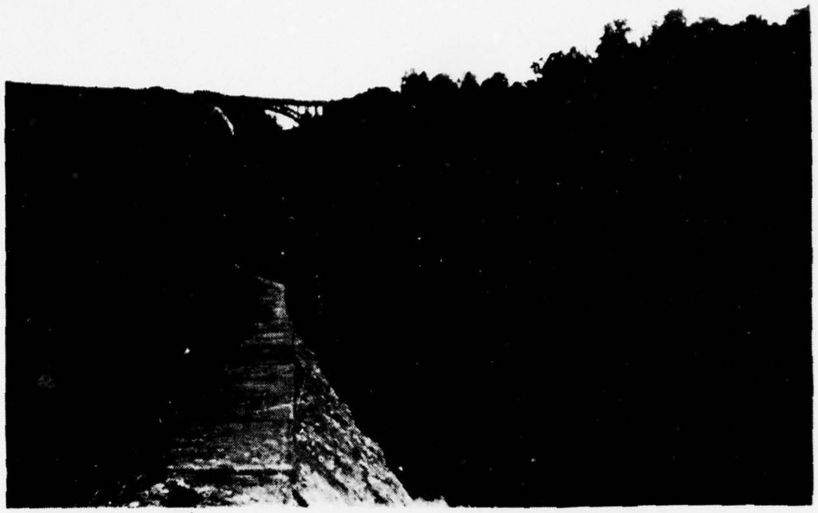


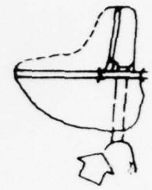
7. Another woodchuck hole showing extent of earth that can be removed. Minor sloughing also occurs.



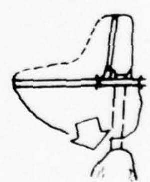


8. Gate house area showing control gate mechanism. Full time staff keeps facility well maintained.

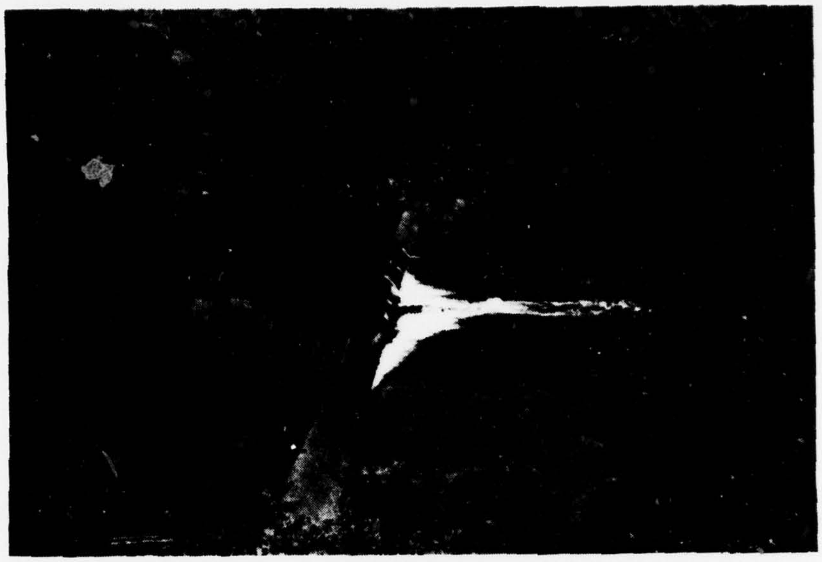


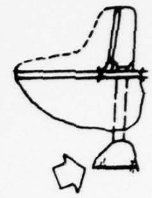


9. View of emergency spillway from stilling basin area. Notice significant vegetative growth in spillway. Left is fence. Discharge tunnel is submerged in basin.

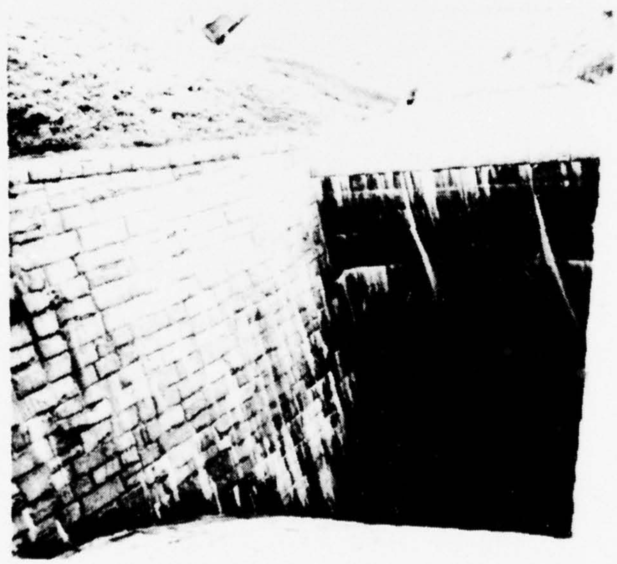


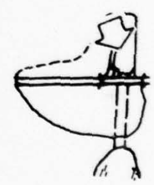
10. View of downstream area below stilling basin.



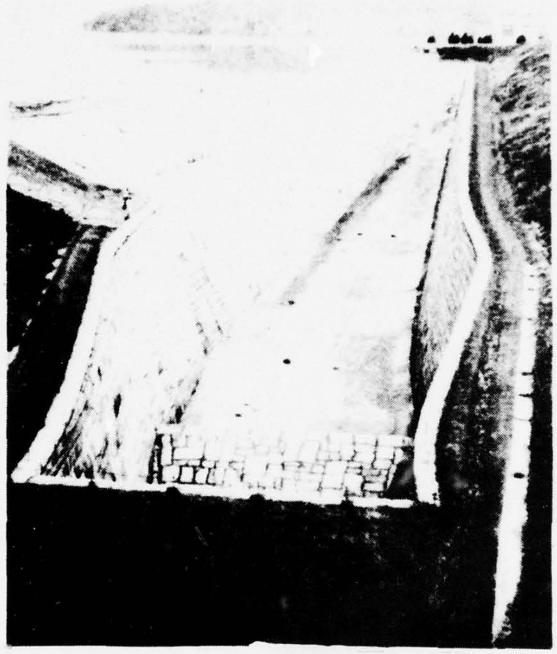


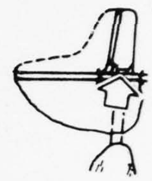
11. Stilling basin weir.





12. View of entrance to discharge tunnel.
Some spalling has occurred.





13. Spillway side channel. Significant spalling has occurred in this area.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM - NEVERSINK ID# - NY617

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

Authority for this report is provided by the National Dam Inspection Act, Public Law 92-367 of 1972. It has been prepared in accordance with a contract for professional services between Dale Engineering Company and The New York State Department of Environmental Conservation.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Neversink Dam and appurtenant structures, owned by the City of New York, and to determine if the dam constitutes a hazard to human life or property and to transmit findings to the State of New York.

This Phase I inspection report does not relieve an owner or operator of a dam of the legal duties, obligations or liabilities associated with the ownership or operation of the dam. In addition, due to the limited scope of services for these Phase I investigations, the investigators had to rely upon the data furnished to them. Therefore, this investigation is limited to visual inspection, review of data prepared by others, and simplified hydrologic, hydraulic and structural stability evaluations where appropriate. The investigators do not assume responsibility for defects or deficiencies in the dam or in the data provided.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

The Neversink Dam is an earth embankment with a concrete cutoff wall. The concrete cutoff wall is founded on rock and extends from the rock foundation up to an elevation of 160 feet below the top of the dam at its center and slopes up to an elevation of 20 feet below the top of the dam near the abutments. The concrete core wall is surrounded by a central core section composed of Class A embankment compacted to 97 percent of maximum density. The remainder of the dam is composed of Class B embankment constructed to less stringent compaction requirements. The Class B embankment is covered by rock to a depth of 20 feet at both the upstream and downstream toes and reducing in depth to 10 feet near the top. The rock embanking is topped with 24 inches of earth cover and 12 inches of topsoil. The upstream slope of the dam is 2-1/2 horizontal to 1 vertical at the top flattening to 3-1/2 on 1 at the

toe. Downstream, the slopes are 3 to 1 at the top and 4 to 1 at the toe. The dam is approximately 3,000 feet long and has a maximum height of approximately 190 feet. The top width of the structure is 60 feet. The upstream face is riprapped for a length of 225 feet along the slope with the riprap terminating at an elevation of approximately 60 feet below the reservoir flow line.

The major spillway is located near the northeast end of the dam and is a side trough spillway with an ogee crest and a trough which discharges into a 30 foot diameter tunnel which conducts the flow to a stilling pool in the Neversink River. An aboveground waste channel is provided to carry flows which cannot be accommodated in the tunnel. This waste channel is spanned by a steel arch bridge which carries a highway across the channel to the dam. Flow in the Neversink River is maintained by regulating a discharge from the reservoir to the discharge tunnel through gates in the control building.

b. Location

The Neversink Dam is located in the Town of Neversink, Sullivan County, New York.

c. Size Classification

The maximum height of the dam is approximatley 190 feet. The storage volume of the dam is approximately 142,000 acre feet. Therefore, the dam is in the large size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

There are many small residential developments situated along the banks of the Neversink River, the receiving stream from the impoundment. Route 55, a New York State Highway traverses across the top of the dam. Therefore, the dam is in the high hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership

The dam is owned by the New York City Bureau of Water Supply.

f. Purpose of Dam

The dam presently functions as a water source for the City of New York. Flows from the impoundment are conducted through the Delaware Aqueduct to the New York City Water System.

g. Design and Construction History

The Neversink Dam was designed by the New York Board of Water Supply. Construction began in 1941 and was completed in 1953. Detailed accounts of the construction may be found in the Delaware Water Supply News which were published during this era.

h. Normal Operational Procedures

The Neversink Dam and Reservoir are actively operated as a water supply for the City of New York. A full-time staff provides routine maintenance and overall surveilance of the dam, reservoir and upland drainage area.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area of the Neversink is 89.5 square miles.

b. Discharge at Dam Site

No discharge records are available at this site.

Computed Discharges:

Ungated spillway, top of dam	120,000 cfs
Ungated spillway, 1/2 PMF	50,400 cfs
Ungated spillway, PMF	98,500 cfs

c. Elevation (feet above MSL)

Top of dam	1460
Maximum pool - PMF	1452
Spillway crest	1440
Stream bed at centerline of dam	1265

d. Reservoir

Length of maximum pool	27,000 feet
Length of normal pool	26,500 feet

e. Storage

Top of dam	142,000 acre feet
Normal pool	112,000 acre feet

f. Reservoir Surface

Top of dam	1750.3 acre
Spillway pool	1477.76 acre

g. <u>Dam</u>

Type - Earth.
Length - 2450 feet.
Height - 190 feet.
Freeboard between normal reservoir and top of dam - 20 feet.
Top width - 60 feet.
Side slopes - 2.5 horizontal to 1 vertical - upstream.
3 horizontal to 1 vertical - downstream.
Zoning - Yes.
Impervious core - Core wall.
Grout curtain - Extensive grouting.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The information available for review of the Neversink Dam included:

1) Contract description of work and specifications or the construction of Neversink Dam, Contract 365, January 2, 1948.

2) Contract description of work and specification for the construction of Neversink Tunnel, Contract 386, January 2, 1948.

3) Drawings titled "Distribution of Various Class B Materials, Place in Neversink Dam", Section at Sta 18 + 00, December 31, 1949, brought up to date December, 1950.

4) Drawing on borrow area locations dated October 31, 1947.

5) Drawing on borrow area No. 1, Soil Analysis dated December 29, 1945.

6) Drawing on borrow area No. 2, Soil Analysis dated December 30, 1946.

7) Drawing on Neversink Tunnel, Contract 386, entitled "Generalized Geologic Sections Showing Geology as Exposed During Excavation".

8) U.S.G.S. quad sheets of the area.

9) See Appendix D of this report for other references.

2.2 CONSTRUCTION

The information regarding the dam's construction is stored in the archives of the New York City Board of Water Supply. A significant amount of information on the construction was obtained from the Delaware Water Supply News (See Appendix D).

2.3 OPERATION

See Section 4.

2.4 EVALUATION

The Engineering data reviewed, indicates that the dam was carefully constructed. A complete evaluation of the vast amounts of data are beyond the scope of this report. Nothing has been found to require additional research for review of such data at this time.

SECTION 3 - VISUAL INSPECTION

3.1 SUMMARY

a. General

The visual inspection of Neversink Dam and Reservoir took place on July 21, 1978. The large earthen dam has, reportedly, not undergone any significant improvements since being put into operation. Mr. Ben Musso, Section Engineer in charge of maintenance of the dam has been working and/or living at the site from the beginning of the dam's construction. He indicated that the New York City Board of Water Supply, designers and managers of construction of the facility, routinely inspected the dam for a number of years after its construction. Early efforts included routine maintenance and record keeping of piezometers and the survey of monuments on top of the dam. Mr. Musso was questioned about an incident referred to in a text on earth dams (Ref. 12) related to internal embankment cracking. The text referring to a discussion in the Delaware Water Supply News (Ref. 7) indicated that the rigid concrete cutoff wall which extended well up into the embankment, produced internal cracking in the embankment due to the high compression stress developed near the top of the concrete structure. This internal cracking reportedly produced a pervious zone 50 feet above the foundation in the otherwise very impervious core area. Mr. Musso indicated he was unaware of this situation. The inspection did not detect any sloughing, seepage or cracking in regards to that specific incident.

b. Dam

The dam and spillway system visually conforms to the plans. The dam embankment is shown in Photographs 2 and 5. A cover crop of crown vetch is being established on the downstream face (See Photograph 2) to eliminate the need for mowing the embankment. At this time, the major portion of the embankment receives periodic mowings. Animal holes have been a continued source of nuisance in maintenance of the embankment. The inspection disclosed approximately 100 woodchuck holes on the dam. Minor sloughing and minor erosion around woodchuck holes is evident in a number of locations on the face of the embankment. The embankment was inspected below the toe and at the abutments with no evidence of sloughing, movement or seepage. The west abutment has outcropping of loose rock material. This material does not show signs of erosion, but should be protected against future erosion potential. The riprap is generally in good condition.

c. Spillway

The spillway is a masonry ogee type structure which falls in three tiers into a large side channel spillway trough. Significant spalling of the concrete floor system with some undermining of the spillway facing has occurred and minor seepage was evident at the time of inspection. The masonry work generally remains in good

condition. Drain covers in the spillway were removed at the time of inspection making the drainage system subject to possible clogging from debris over the spillway. The spillway discharge tunnel was viewed from above but no visual assessment could be made of the structure.

d. Appurtenant Structures

The drawdown intake structure was visited in the below grade intake area. It was demonstrated by the Bureau of Water Supply that the system was operating properly.

e. Reservoir Area

The reservoir area is generally forested; some exposed ground areas have contributed relatively small amounts of erosion and sediment into the reservoir in the past. The Bureau of Water Supply has planted trees in these areas to stabilize the bank of the reservoir.

f. Downstream Channel

The downstream channel was found to be in good condition.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures were not observed by the inspection team. The dam and reservoir is owned by the New York City Board of Water Supply and are maintained by the staff of the Delaware Division located in Grahamsville, New York. It is the staff's responsibility to maintain and operate the facilities under the direction of the central office in New York City. Operators are believed to be on duty at all times at the site. Mr. Ben Musso indicated operation manuals and/or procedures are documented for all appurtenances. During normal conditions, the water surface elevation of the reservoir is at the spillway crest.

Control gates in the intake chamber building can divert flows via a tunnel into Rondout Reservoir and into the Delaware Aqueduct system and/or into the Neversink River. Maximum discharge in Neversink River under normal head is 200 MGD, while maximum discharge into Rondout is 500 MGD. Neversink Reservoir contains 37 billion gallons of water. The New York City Water Board augments discharges into the Delaware River System to meet minimum daily flow requirements according to a Delaware River Basin Agreement. During hot summer weather periods, flows are augmented above the minimum level to provide a proper dissolved oxygen-temperature relationship to support fish populations downstream of the dam.

4.2 MAINTENANCE OF DAM

The dam is maintained by its full-time maintenance staff. The Delaware Division Operations Center has a complete staff capable in operation and maintenance engineering for the facility.

SECTION 5 - HYDROLOGY AND HYDRAULICS

5.1 EVALUATION OF FEATURES

a. Design Data

For this report, no information relevant to the hydrologic and/or hydraulic design for the dam was available. Analysis provided in Appendix C was performed utilizing information obtained from construction documents and other general sources of information listed in the reference section of this report. Dimensions used in the hydraulic studies were scaled from the plans (in some instances, dimensions were scaled at 1 inch = 100 feet).

The massive earth embankment of the Neversink Dam spans the valley of the Neversink River, a tributary of the Delaware River, forming the Neversink Reservoir. The drainage area contributing to the reservoir is approximately 90 square miles, including 3 square miles of reservoir water surface. The volume of the impounded water is a function of the natural watershed. For the purpose of this investigation, the dam and spillway were analyzed with respect to their flood control potential. This potential was assumed through the development of the Probable Maximum Flood (PMF) for the watershed and the subsequent routing of the PMF through the reservoir system. The PMF is that hypothetical flow induced by the most critical combination of precipitation, minimum infiltration losses and concentration of run-off at a specific location that is considered reasonably possible for a particular drainage area. For the dam location, little hydrologic information was found available from previous studies.

The hydrologic analysis was performed using the unit hydrograph method to develop the flood hydrograph. An attempt was made to acquire data from U.S.G.S. on their stream gage at Neversink which is below the dam. The gage, which was installed in 1941, had recorded a significant event on November 25, 1950 with a peak discharge of 22,300 cfs prior to the dam's construction. The record of the flood hydrograph is being located in U.S.G.S.'s archives. This data was not available at the time of preparation of this report. An attempt to reconstitute this flood using unit hydrograph parameters is shown in Appendix C. A magnitude of only 12,000 cfs was derived using only PMF criteria (i.e. loss rating etc.). In addition to the stream gage record for the flood, additional rainfall data is needed to prepare an isohyetal map for the storm over the drainage area. For this study only a limited amount of recorded rainfall data for the flood event was available, whereas, additional non-recording data will be needed to complete this particular analysis.

Using only available information, both Clark and Snyder coefficients for unit hydrograph parameters were estimated. For the Clark Method, values of $Tc = 7.40$ and $R = 3.17$ were computed. For the Snyder Method, values of $Tpr = 5.2$ and $CP = 0.625$ were used to

derive two unit hydrographs and two flood hydrographs. The more severe discharge was then used as the flood hydrograph in the spillway flood analysis.

The Probable Maximum Flood (PMF) hydrograph was determined using Probable Maximum Precipitation rainfall data obtained in Hydro-meteorlogical Report No. 51. An index rainfall of 24.0 inches for a 200 square mile area for a period of 24 hours was adopted for the analysis. Both the PMF and 1/2 PMF (SPF) were evaluated. The 1/2 PMF was assumed to be approximately the Standard Project Flood (SPF) in utilizing the U.S. Army Corps of Engineers Hydrologic Engineering Center's Computer Program UHCOMP. The peak discharges for the Clark Method were 57,000 cfs for the 1/2 PMF (SPF) and 107,300 for the PMF. The peak discharges for the Snyder Method were 60,000 for the 1/2 PMF (SPF) and 113,300 for the PMF.

Hydraulic studies were performed on the side channel spillway, the side channel trough, and discharge tunnel. These computations are included in Appendix C. A spillway rating curve was obtained from this analysis. The weir control (with free discharge) was found to be in effect up through a discharge of 75,000 cfs at elevation 1450 at which time weir submergence occurs. The stage-discharge relationship was developed up through elevation 1454 with a spillway flow of 102,100. At this elevation, the waste channel was computed to be flowing at a depth of around 30 feet with the discharge tunnel flowing at a capacity of 48,300 cfs.

The flood hydrographs derived using Snyder's parameters were routed over the structure using the U.S. Army Corps of Engineers Hydrologic Engineering Center's Progam HEC-1 using the Modified Puls Method. No drawndown conduits were included in this flood routing. The peak flow discharges were approximately 50,400 and 98,500 cfs for the 1/2 PMF (SPF) and PMF events. These discharges reflect a reduction greater than 15 percent in peak discharge due to the effect of the large reservoir and a significant allocation of surcharge freeboard above the normal pool elevation. The computed stage-discharge relationship in Appendix C indicates that the dam would pass the PMF with 7 feet of freeboard. This appears to be a safe margin. The Clark and Snyder parameters producing similar unit hydrographs from very generalized data. It would be prudent to complete the work started with reconstitution of the flood of record to verify the derived unit hydrograph.

b. Experience Data

Information obtained from knowledgeable people at the site indicates that the spillway is flowing during the spring of each year. Since the dam's construction, no significant flows relative to spillway capacity have been reported.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations and Data Review

The dam embankment shows no misalignment, sloughing, surface cracks or erosion which would indicate structural movement or distress. Riprap on the upstream face of the embankment and reservoir slopes in the vicinity of the spillway area is generally in good condition. The downstream slope of the embankment is covered with grasses which are mowed. A crown vetch cover crop is being implanted on the downstream face. No indication of seepage was noted on the embankments downstream slope or surface area immediately beyond the downstream toe. Many small animal burrows were noted on the downstream face.

The sites shale rock is exposed in the impounding slope along the western side of the reservoir, in the vicinity of the dams westerly abutment. At the area close to the abutment, the shale has become "benched" at several levels. The weathered shale residue (soil-size pieces) remains accumulated on the slope. The condition does not appear to be effecting the abutment area of the dam.

The stone masonry spillway (waste weir) is generally in structurally good condition, but limited seepage occurs through the spillway masonry. The floor of the spillway chute (weir channel) consists of poured concrete. Deterioration (spalling and cracking) of this concrete has occurred at several locations. Masonry for the waste channel downstream of the spillway weir channel generally is in good condition.

b. Geology and Seismic Stability

The general area encompassing the reservoir site is underlain by Upper Devonian sandstone, siltstone, and shale of the Walton Formation. A geologic section of the subsurface for the centerline of the dam shown in the Delaware Water Supply News (pages 704-705) clearly depicts the subsurface materials based upon borings and excavations.

Geologically, the area shale tends to weather readily and thus often gives the appearance of severely disintegrated rock, in time. Occasionally, siltstones also weather easily.* Although the bedding is essentially horizontal in this area, there is extensive high angle jointing present.**

Neither the New York State Geologic Map (1970) nor the Preliminary Brittle Structures Map of New York of the New York State Geologic Survey (1971) indicate the presence of faults in the general region of the reservoir. However, the geologic section shown in the Delaware Water Supply News (page 704) indicates the presence of a decayed crush zone near the west slope of the dam site. A crush zone usually is suggestive of faulting. The only known earthquake recorded for this area, occurring in 1957 about 18 miles southwest of the reservoir, registered 3.5 on the Richter Scale. The dam is located in an area designated Zone 1 on the Seismic Probability map.

c. Data Review and Stability Evaluation

Various design, construction, and as-built drawings have been available for review, as has been considerable written material on the different aspects of construction appearing in the Delaware Water Supply News.

The design information indicates this dam to be an earthen structure that is provided with a central concrete cutoff wall which extends to rock. In the dams originally deeper valley section, the cutoff wall is supported on caisson foundations which penetrate to sound rock underlying the site. The earthen embankment is constructed with a core section and a cutoff trench section (surrounding the concrete cutoff wall) of impervious clay. The lower section of the outer shell portions are constructed with semi-impervious clay mixture soils. Pervious sand and gravel material was utilized for the upper sections of the outer shell.

* Such weathered materials would not make a good dam foundation. Sheet No. 13 of Contract 386 in the dam's construction required all such materials be removed down to solid rock. The Delaware Water Supply News, reporting on construction of the dam, indicates all such weathered material encountered was removed.

** A significant amount of grouting was done in order to prevent seepage through the bedding planes and joints (Delaware Water Supply News, page 701).

An earth slope of 2-1/2 to 1 (horizontal to vertical) is utilized for the upper portion of the upstream face; the lower section of the upstream face is constructed at a 3-1/2 to 1 (horizontal to vertical) slope. On this upstream face, the upper section is provided with a dry rubble paving (riprap), with the lower section having a surface of rock embanking. On the downstream face, a slope of 3 to 1 (horizontal to vertical) has been utilized for the upper section of the dam, with a 4 to 1 slope being used for the lower section. A rock embanking cover is provided for the downstream slope of the structural embankment. An approximately three foot thickness of plain earth and topsoil (for grassing) overlies the downstream rock embanking. A toe zone of rock embanking is also indicated for the downstream slope.

Visually, the embankment is in good condition with no indication of instability, deterioration, or seepage problems. The literature review indicates that some cracking of embankment was experienced near to the cutoff wall during construction, probably from settlement of the foundation soils, but no remaining indication of that or other structural problems was evident at the time of the field inspection. The dams design is in general accordance with the engineering professions past practice for similar type structures where satisfactory performance has resulted. It is anticipated that, properly maintained, this dam will continue to serve satisfactorily for future loading conditions which are similar to those of the past. Maintenance should extend to protection of the (eroding) natural shale exposed along the western side of the reservoir adjacent to the westerly abutment, and include repair of deteriorated concrete in the spillway area.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

On the basis of the Phase I visual examination, the earth embankment of the Neversink Dam appears to be adequate for normal reservoir operation. A vast amount of narrative information (See References, Appendix D) on this structure has been reviewed, however, the data is far short of being complete. In general, the data indicates that the structure has been designed using modern standards. The New York Board of Water Supply has not been able to provide design data which is located in their archives.

The dam embankment shows no sign of movement, seepage or distress and is generally in good condition. The visual inspection located a significant number of animal holes, believed to be woodchuck holes, in the downstream embankment. The holes have caused minor sloughing and erosion and present a nuisance to individuals who have to mow and maintain the dam embankment. The New York Department of Environmental Conservation Fish and Game Section indicate woodchucks will burrow very close to the surface (See Appendix E) and should not be capable of causing piping in a large dam. The downstream face of the dam is being implanted with crown vetch in an effort to minimize mowing and maintenance work. This will make it difficult to visually inspect the embankment surface and is not beneficial to overall dam safety considerations. It is important to notice problems at the embankment at an early stage. While frequent mowing of the embankment can be a significant expense, it allows the dam owner the opportunity to routinely visually inspect the embankment surface.

A minor amount of seepage was located in the spillway masonry. Deterioration of the spillway trough has also occurred in a number of locations. Some weathered shale rock was noticed on the west abutment. The condition does not appear to be effecting this abutment area of the dam. The dam has been found capable of passing the Probable Maximum Flood with 7 feet of freeboard based on the analysis prepared in this report. Further work on verification of the unit hydrograph, the basis for the flood routing, has been suggested.

7.2 REMEDIAL MEASURES

a. Alternatives

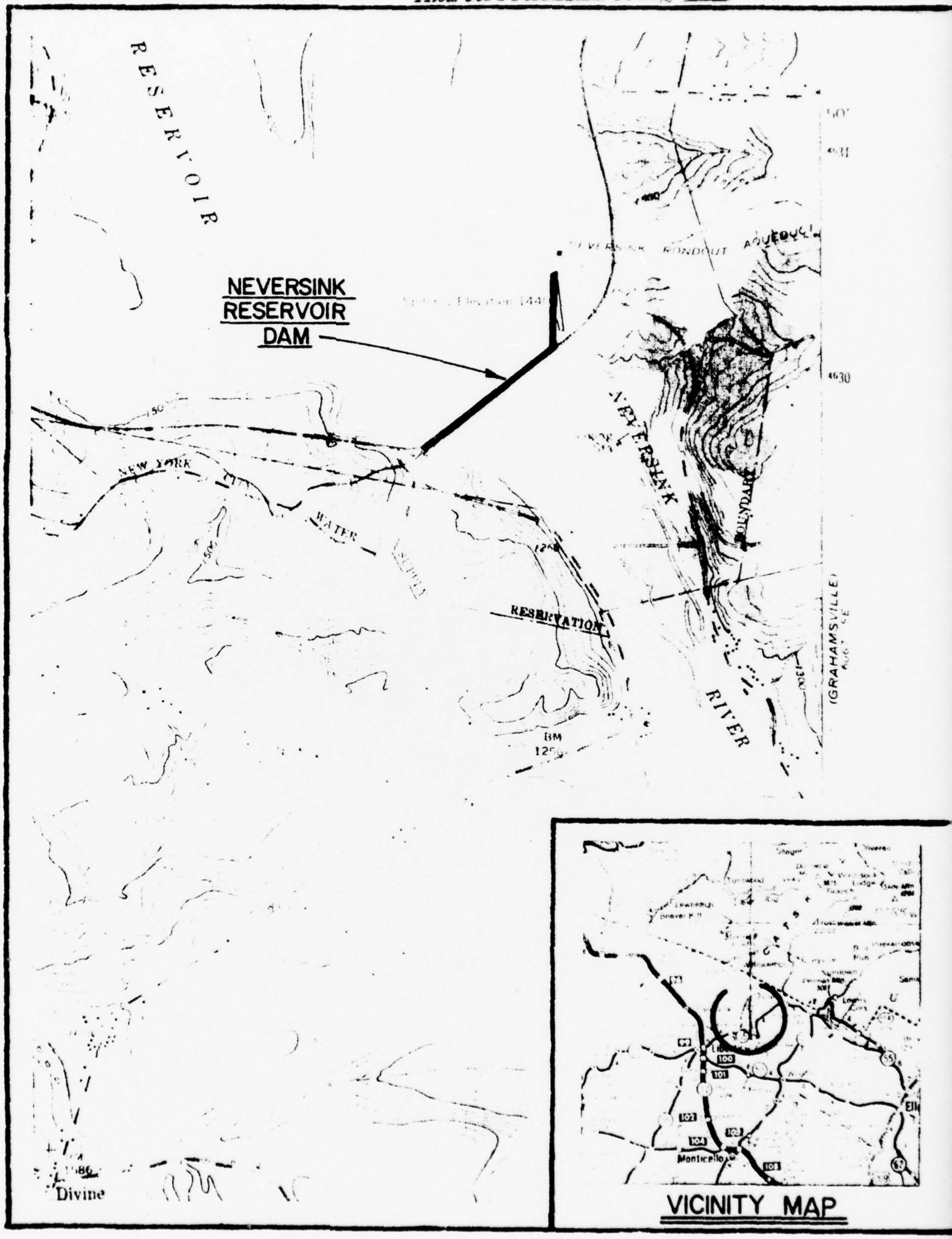
The following recommendations are made following this investigation.

1) The downstream embankment should not be planted with crown vetch plant material. The embankment should continue to be mowed.

2) Minor erosion and sloughing problems from animal holes should be attended to.

3) Deteriorated concrete surfaces in the spillway area should be repaired.

4) The exposed shale along the face of western upstream abutment of the reservoir should be protected from erosion.



LOCATION PLAN

FIGURE 1

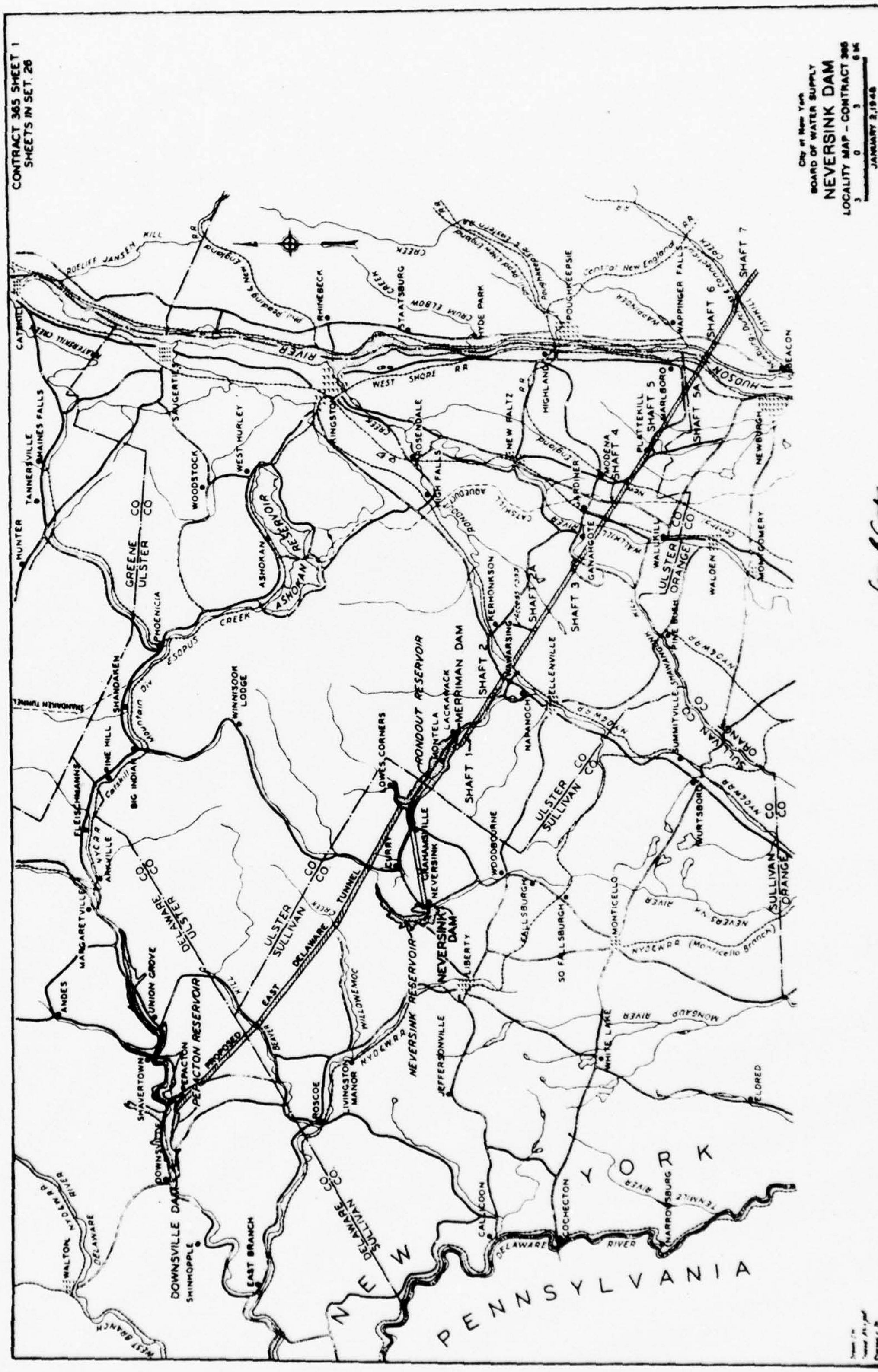

CONTRACT 385 SHEET 1
SHEETS IN SET 28
BOARD OF WATER SUPPLY
NEVERSINK DAM
LOCALITY MAP - CONTRACT 385
NEW YORK
PENNSYLVANIA
NEVERSINK RESERVOIR
NEVERSINK DAM
RONDOUT RESERVOIR
MERRIMAN DAM
PEPACTON RESERVOIR
DOWNSVILLE DAM
ASHOKAN RESERVOIR
EAST DELAWARE TUNNEL
HUDSON RIVER
DELAWARE RIVER
ESOPUS CREEK
SHAFT 1
SHAFT 2
SHAFT 2A
SHAFT 3
SHAFT 4
SHAFT 5
SHAFT 5A
SHAFT 6
SHAFT 7
KINGSTON
POUGHKEEPSIE
NEWBURGH
BEACON
LIBERTY
ELLENVILLE
MONTICELLO
ROSCOE
PHOENICIA
WOODSTOCK
SAUGERTIES
CATSKILL
HUNTER
ANDES
WALTON
ULSTER
SULLIVAN
ORANGE
GREENE
DELAWARE

FIGURE 2


CONTRACT 385 SHEET 2
SHEETS IN SET, 26
BOARD OF WATER SUPPLY
NEVERSINK DAM
LOCATION PLAN
NEVERSINK DAM
BORROW AREA NO 1
NEVERSINK
RIVER

FIGURE 3

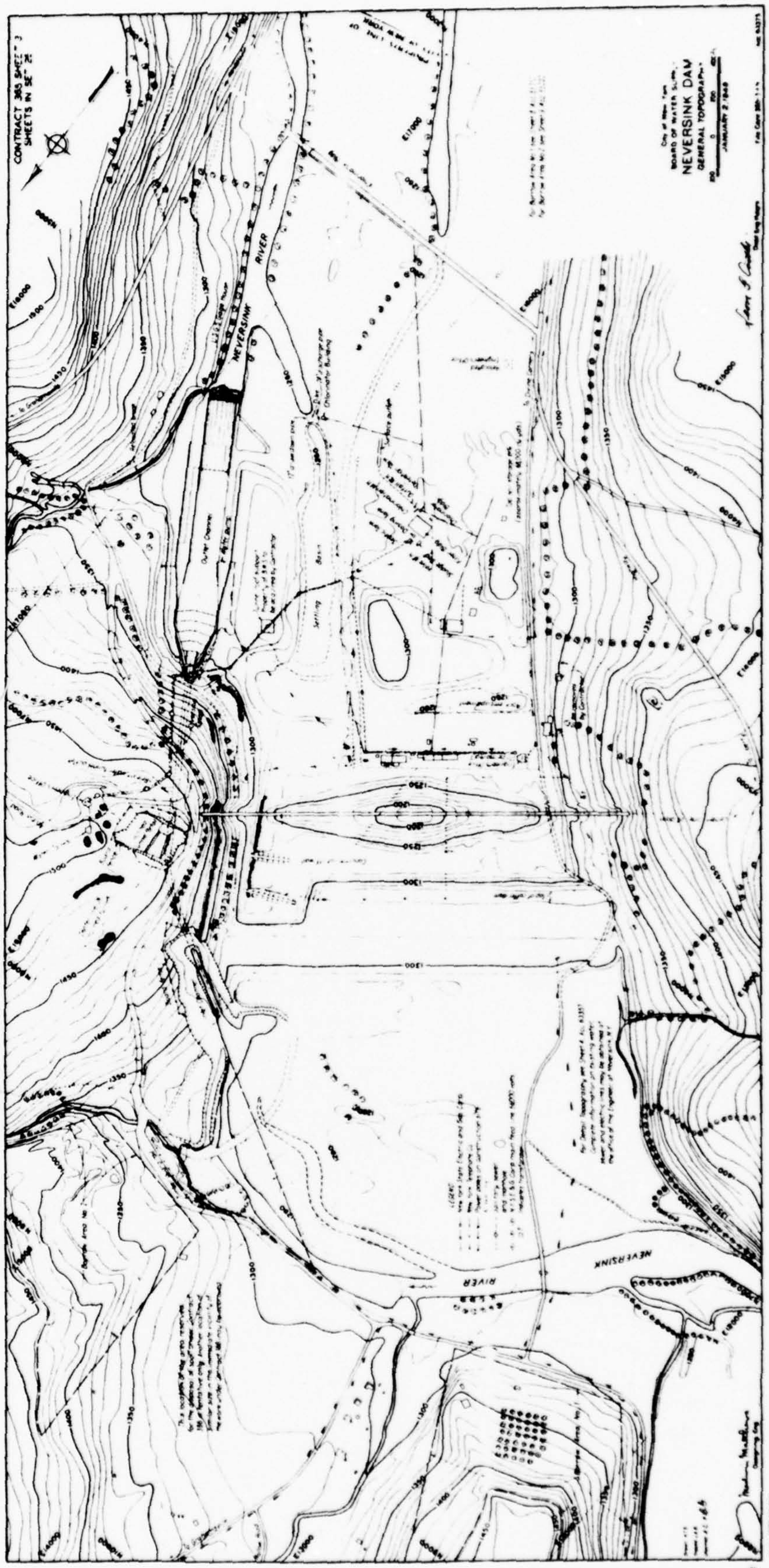


FIGURE 4

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FROM COPY FURNISHED TO DDC

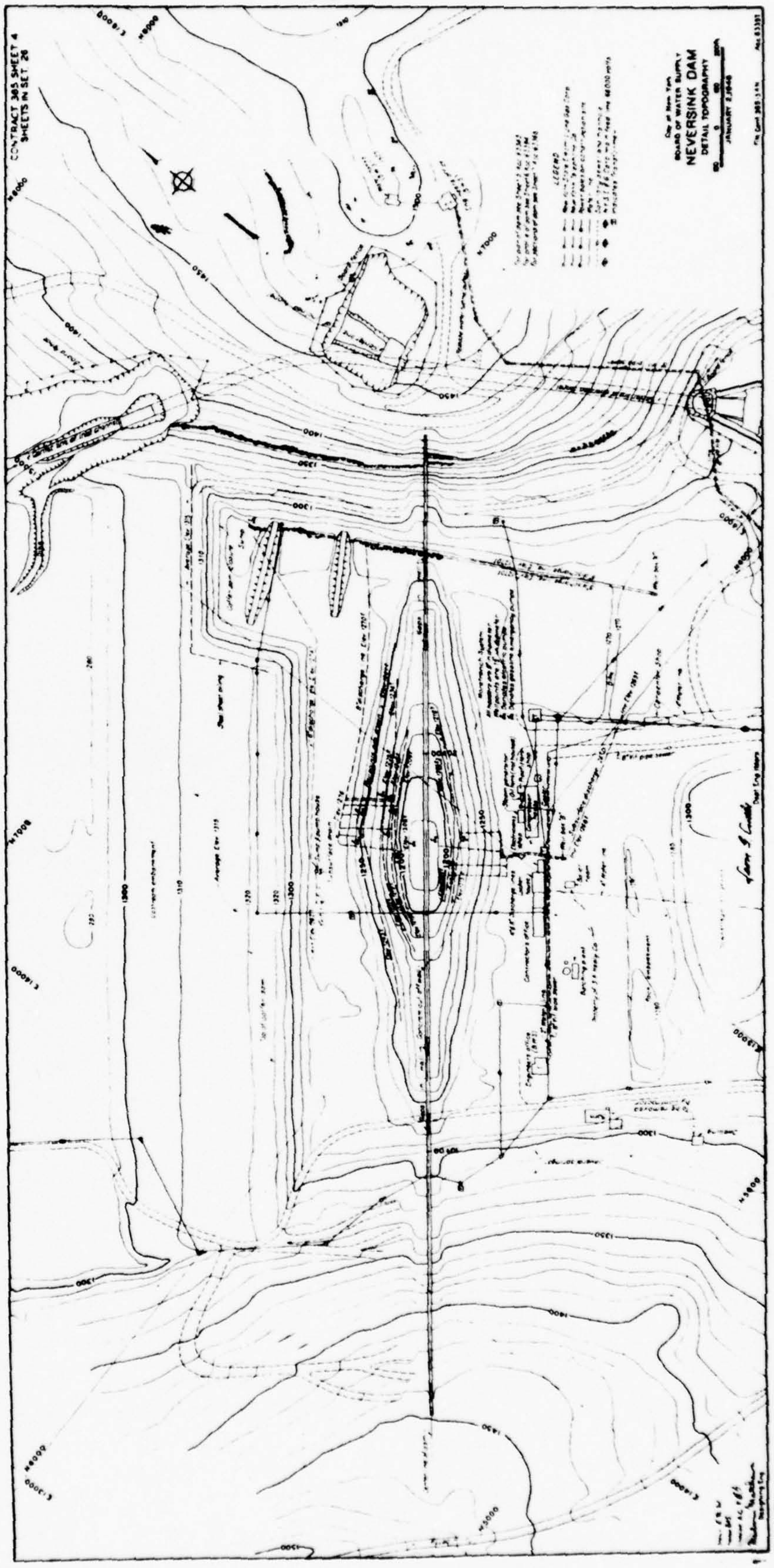


FIGURE 5

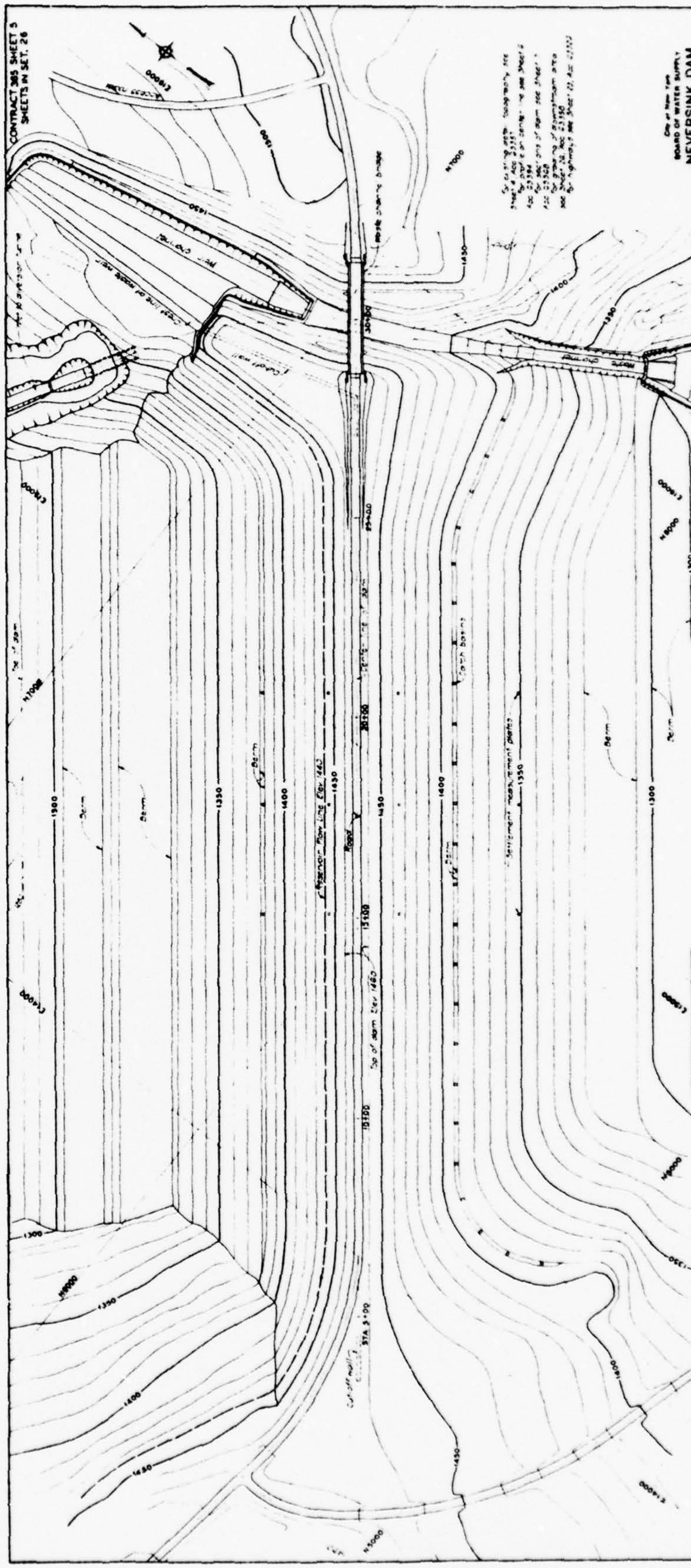

CONTRACT 325 SHEET 5
SHEETS IN SET 26
BOARD OF WATER SUPPLY
NEVERSINK DAM
PLAN

FIGURE 6

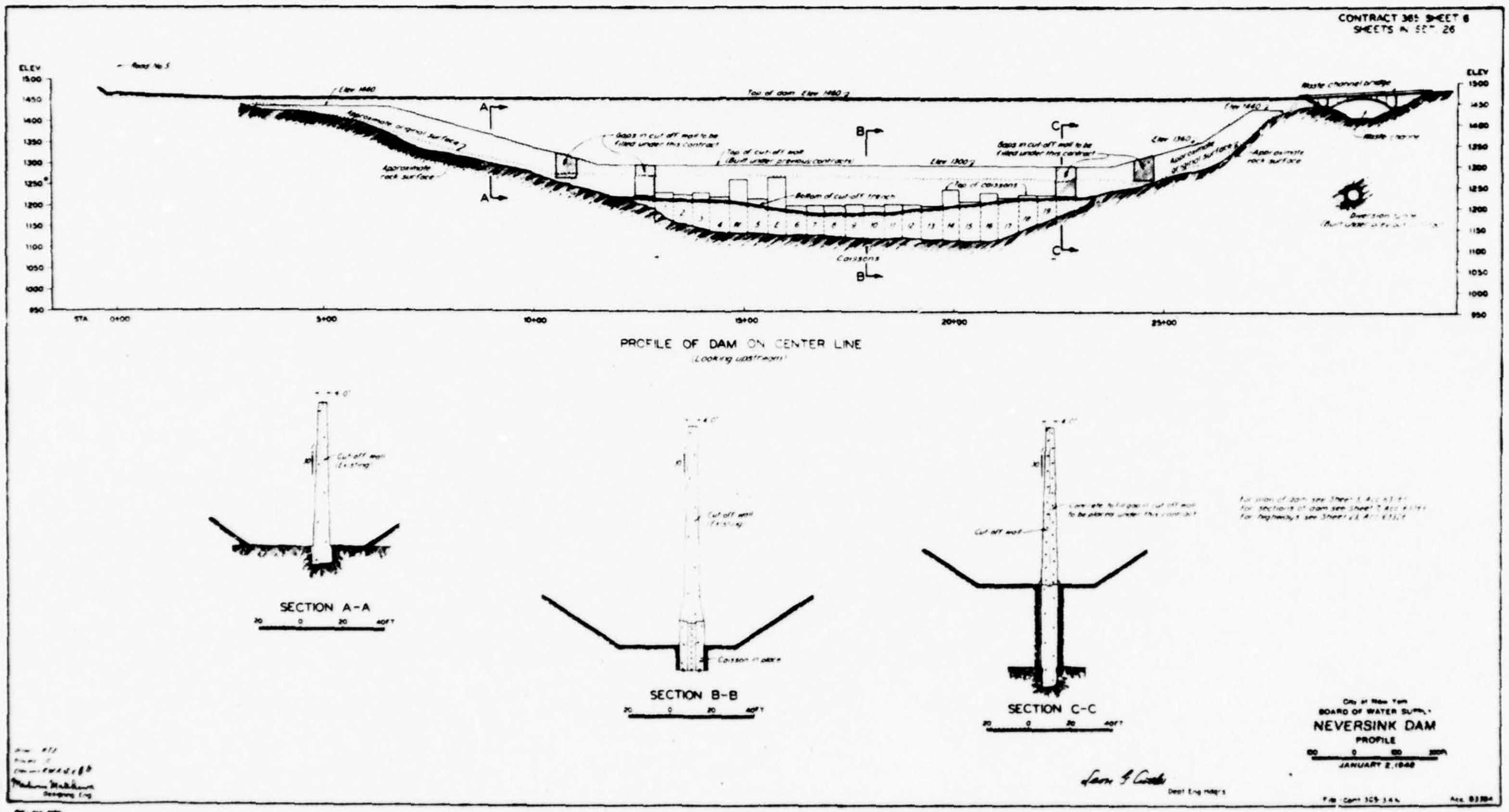

CONTRACT 385 SHEET 6
SHEETS IN SECT. 26
ELEV
Top of dam Elev 1480±
Waste channel bridge
Approximate original surface
Approximate rock surface
Bottom of cut-off trench
Top of caissons
Caissons
PROFILE OF DAM ON CENTER LINE
(Looking upstream)
SECTION A-A
SECTION B-B
SECTION C-C
City of New York
BOARD OF WATER SUPPLY
NEVERSINK DAM
PROFILE
JANUARY 2, 1948

FIGURE 7

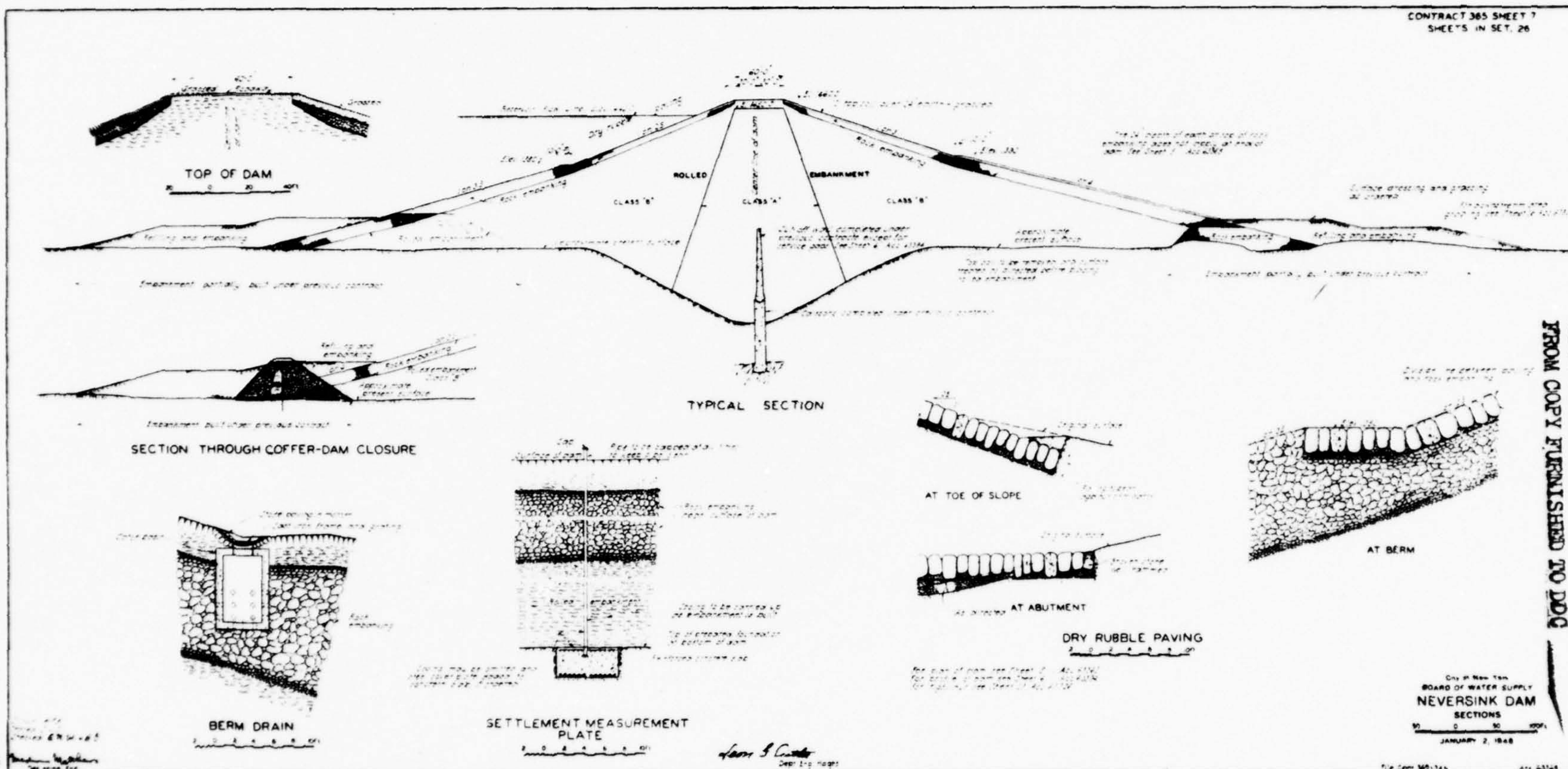

CONTRACT 365 SHEET 7
SHEETS IN SET 26
TOP OF DAM
ROLLED
EMBANKMENT
CLASS "B"
CLASS "A"
CLASS "B"
TYPICAL SECTION
SECTION THROUGH COFFER-DAM CLOSURE
BERM DRAIN
SETTLEMENT MEASUREMENT PLATE
AT TOE OF SLOPE
AT ABUTMENT
AT BERM
DRY RUBBLE PAVING
City of New York
BOARD OF WATER SUPPLY
NEVERSINK DAM
SECTIONS
JANUARY 2, 1948

FIGURE 8

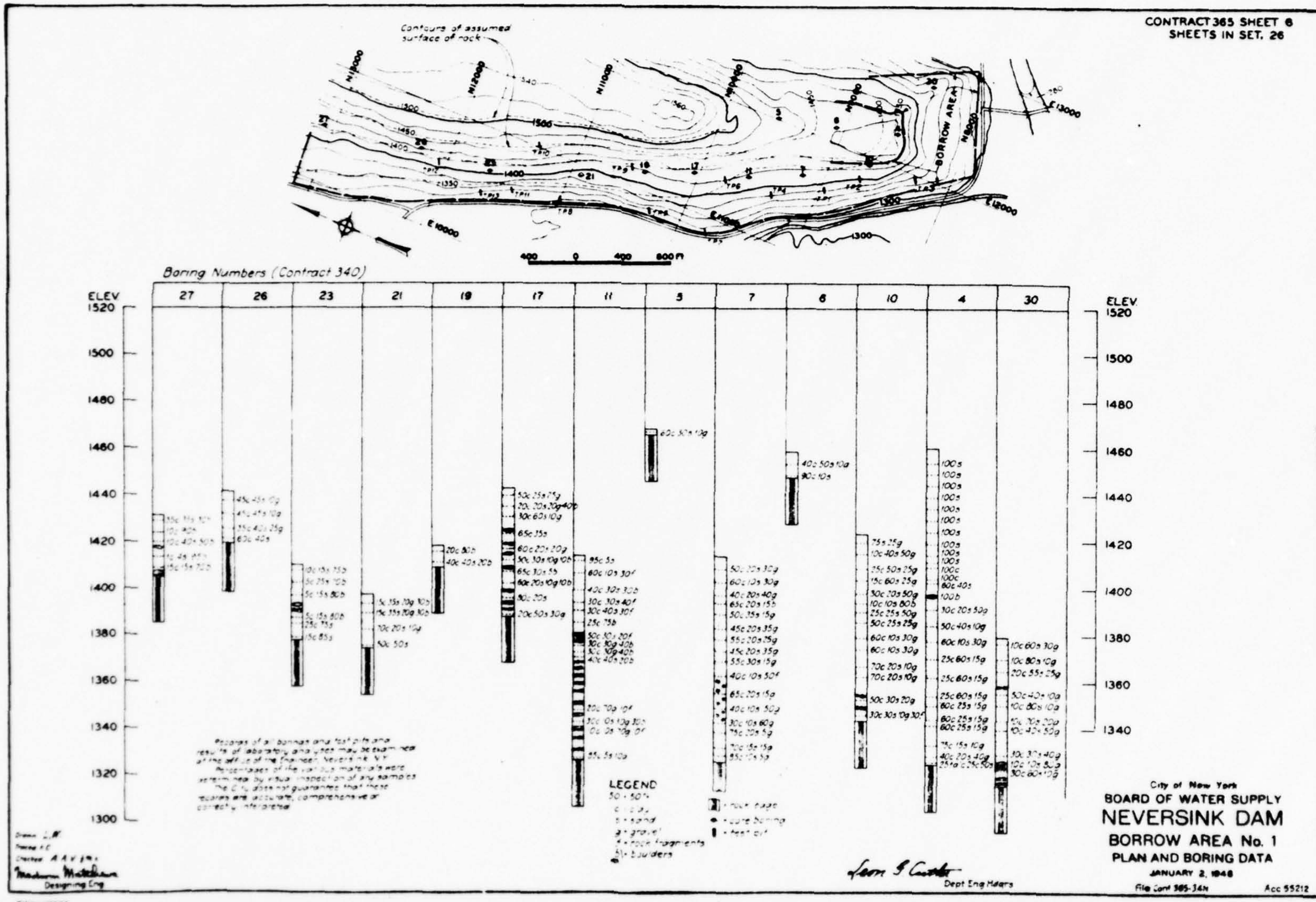

CONTRACT 365 SHEET 6
SHEETS IN SET. 26
Contours of assumed surface of rock
BORROW AREA
Boring Numbers (Contract 340)
27
26
23
21
19
17
11
5
7
6
10
4
30
ELEV
1520
1500
1480
1460
1440
1420
1400
1380
1360
1340
1320
1300
LEGEND
City of New York
BOARD OF WATER SUPPLY
NEVERSINK DAM
BORROW AREA No. 1
PLAN AND BORING DATA
JANUARY 2, 1948
Dept Eng Hdqrs
Designing Eng
Acc 55212

FIGURE 9

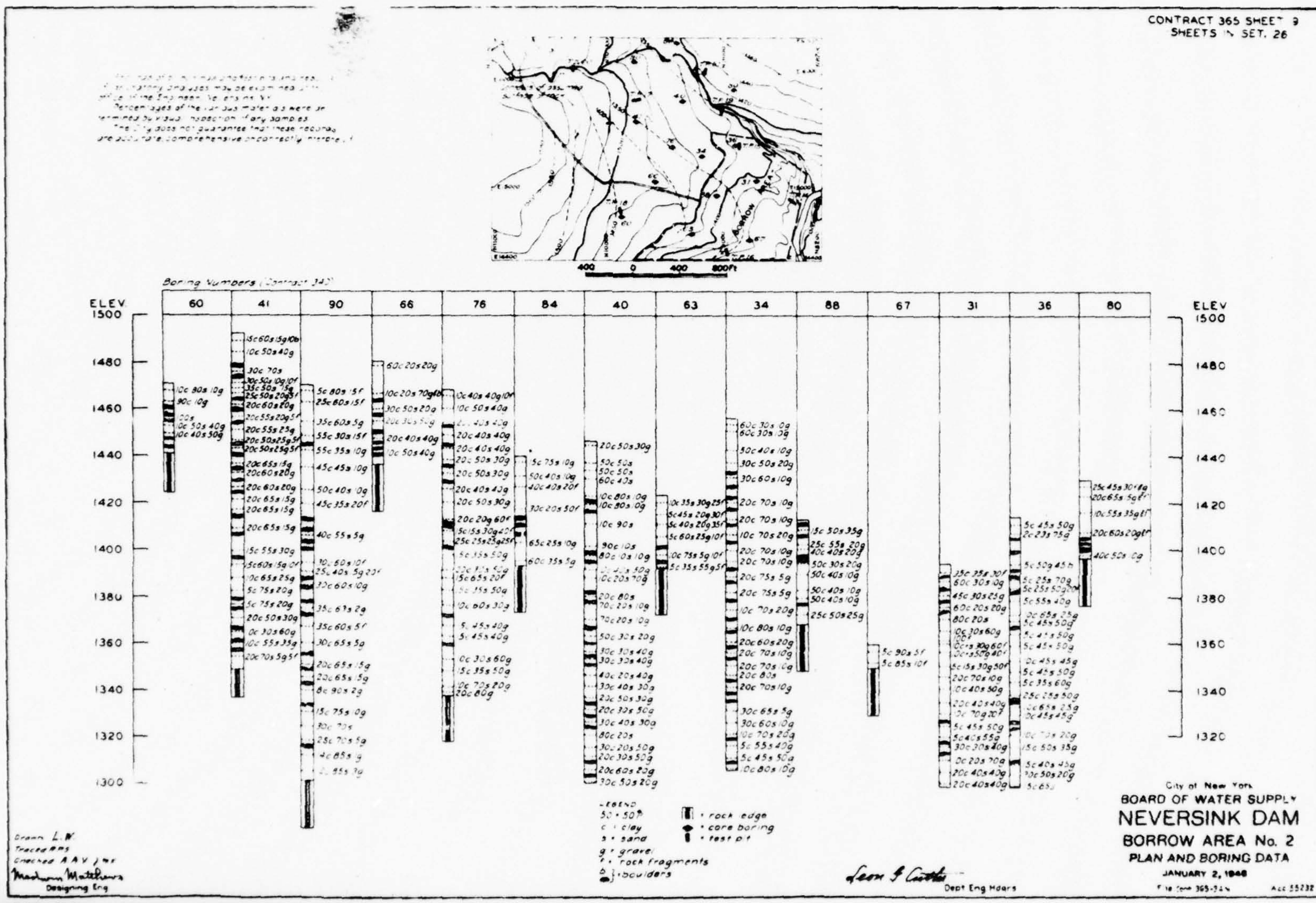

CONTRACT 365 SHEET 9
SHEETS IN SET. 26
Boring Numbers (Contract 345)
ELEV
1500
1480
1460
1440
1420
1400
1380
1360
1340
1320
1300
60
41
90
66
76
84
40
63
34
88
67
31
36
80
LEGEND
c = clay
s = sand
g = gravel
rock edge
core boring
test pit
rock fragments
boulders
400
0
400
800 ft
City of New York
BOARD OF WATER SUPPLY
NEVERSINK DAM
BORROW AREA No. 2
PLAN AND BORING DATA
JANUARY 2, 1948
Dept Eng Hdqrs
Drawn L.W.
Designing Eng

FIGURE 10

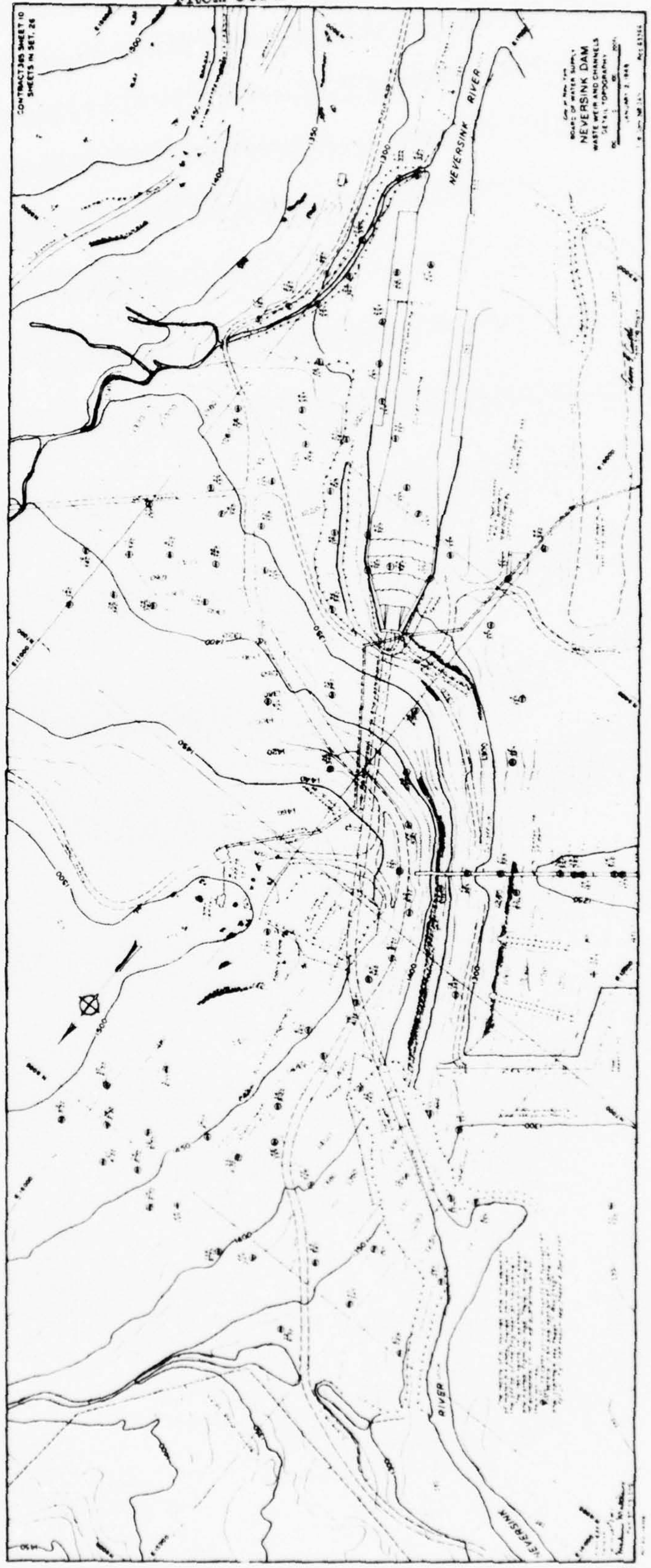
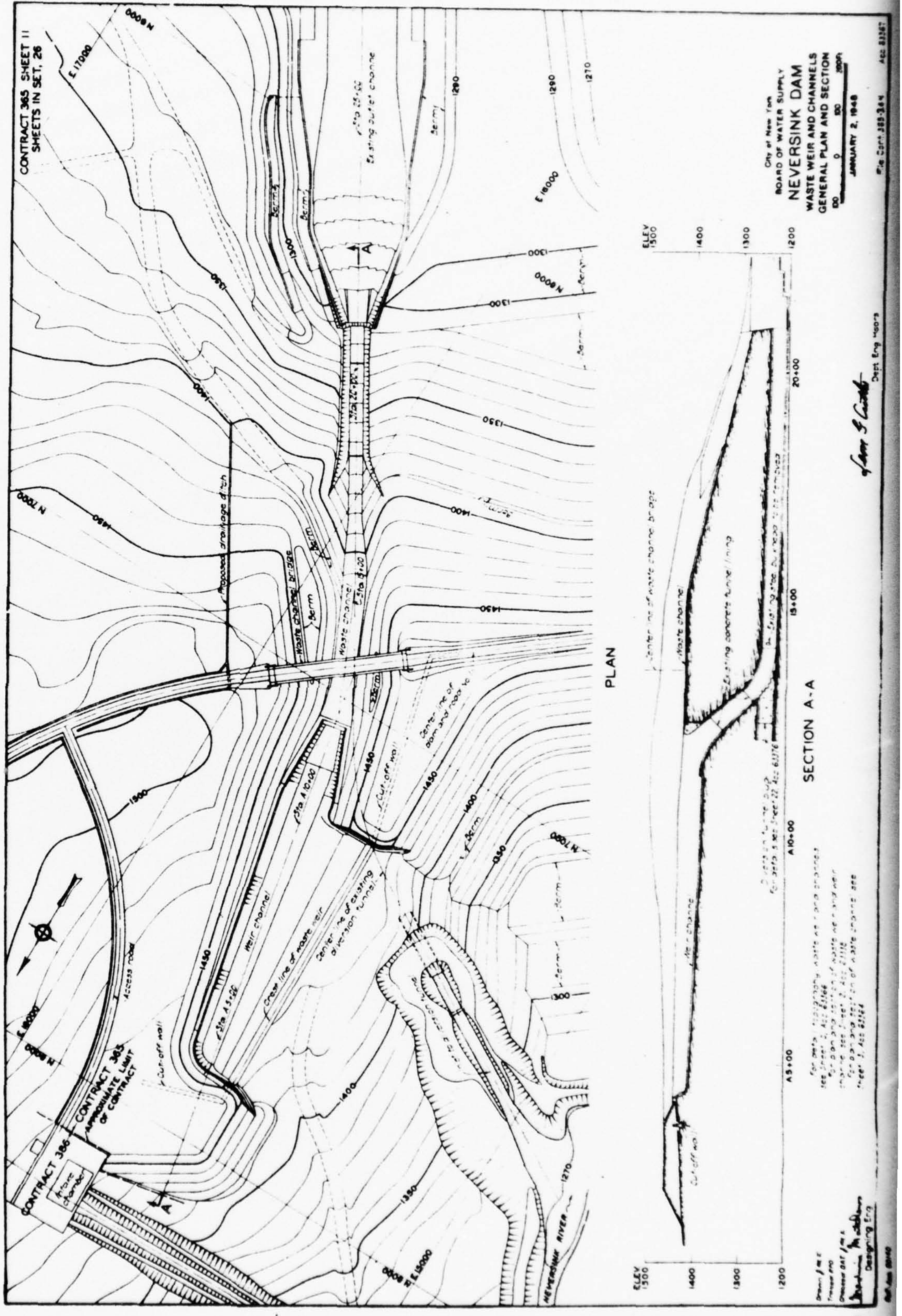

BOARD OF WATER SUPPLY
NEVERSINK DAM
WASTE WEIR AND CHANNELS
DETAIL TOPOGRAPHY
NEVERSINK RIVER
NEVERSINK
RIVER

FIGURE 11


CONTRACT 365 SHEET 11
SHEETS IN SET, 26
PLAN
SECTION A-A
City of New York
BOARD OF WATER SUPPLY
NEVERSINK DAM
WASTE WEIR AND CHANNELS
GENERAL PLAN AND SECTION
JANUARY 2, 1948
CONTRACT 386
CONTRACT 365
APPROXIMATE LIMIT OF CONTRACT
Access road
Weir channel
Waste channel
Waste channel bridge
Proposed drainage ditch
Cut-off wall
Crest line of waste weir
Center line of existing diversion tunnel
NEVERSINK RIVER
Existing outlet channel
Berm
ELEV

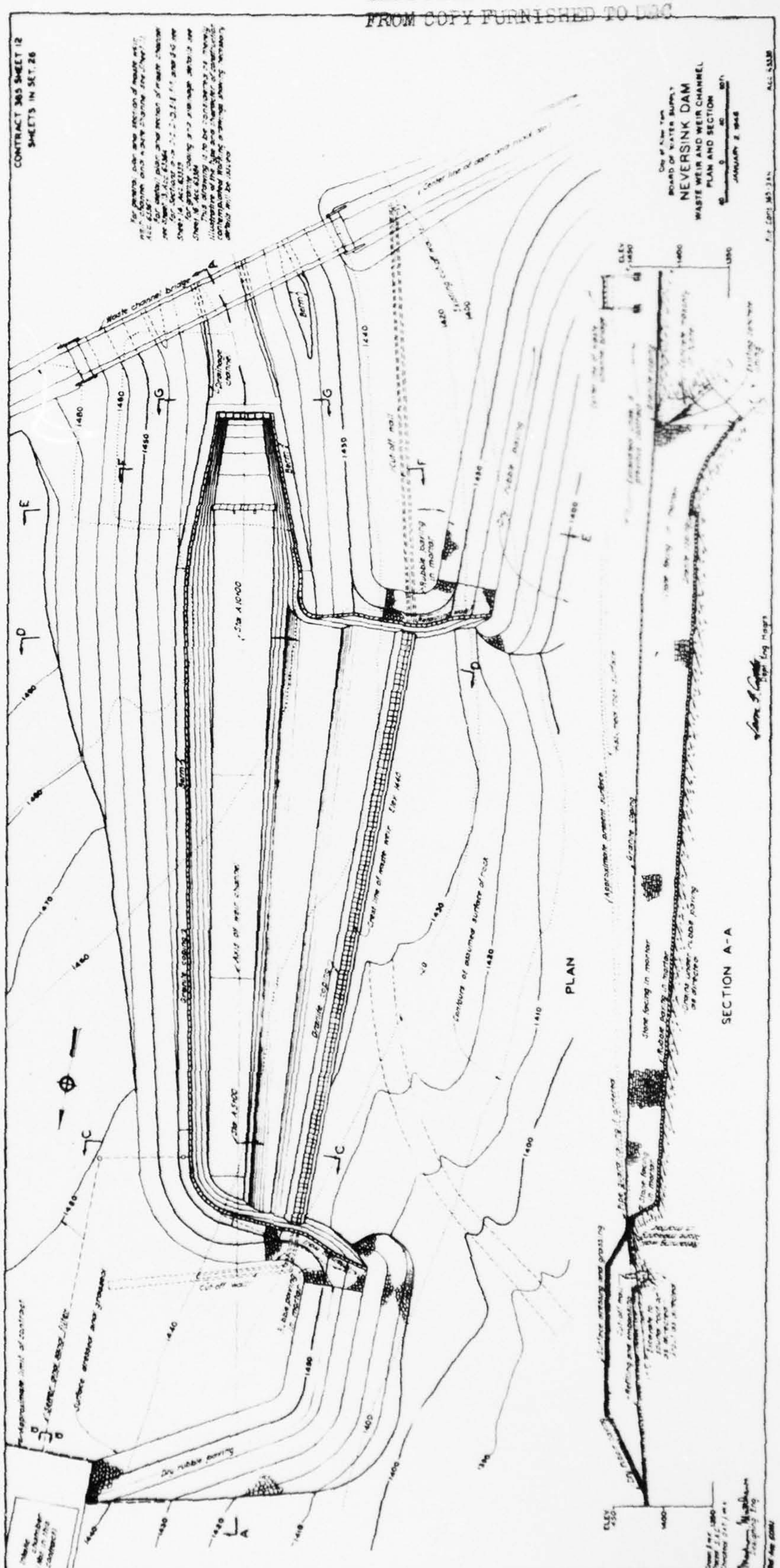

CONTRACT 363 SHEET 12
SHEETS IN SET 26
BOARD OF WATER SUPPLY
NEVERSINK DAM
WASTE WEIR AND WEIR CHANNEL
PLAN AND SECTION
PLAN
SECTION A-A

FIGURE 13

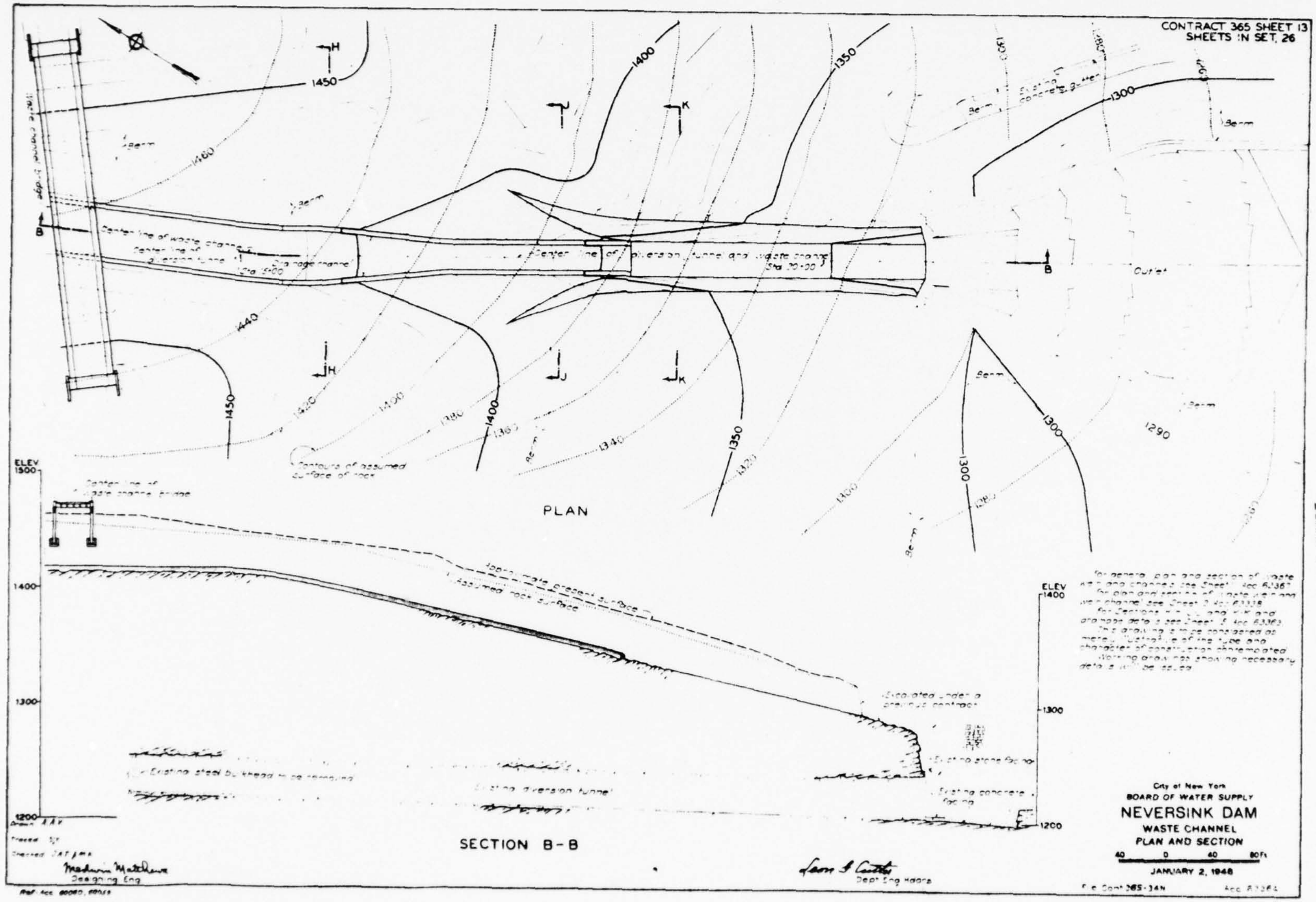

CONTRACT 365 SHEET 13
SHEETS IN SET 26
PLAN
SECTION B-B
Outlet
Berm
ELEV
1500
1400
1300
1200
City of New York
BOARD OF WATER SUPPLY
NEVERSINK DAM
WASTE CHANNEL
PLAN AND SECTION
JANUARY 2, 1948

FIGURE 14

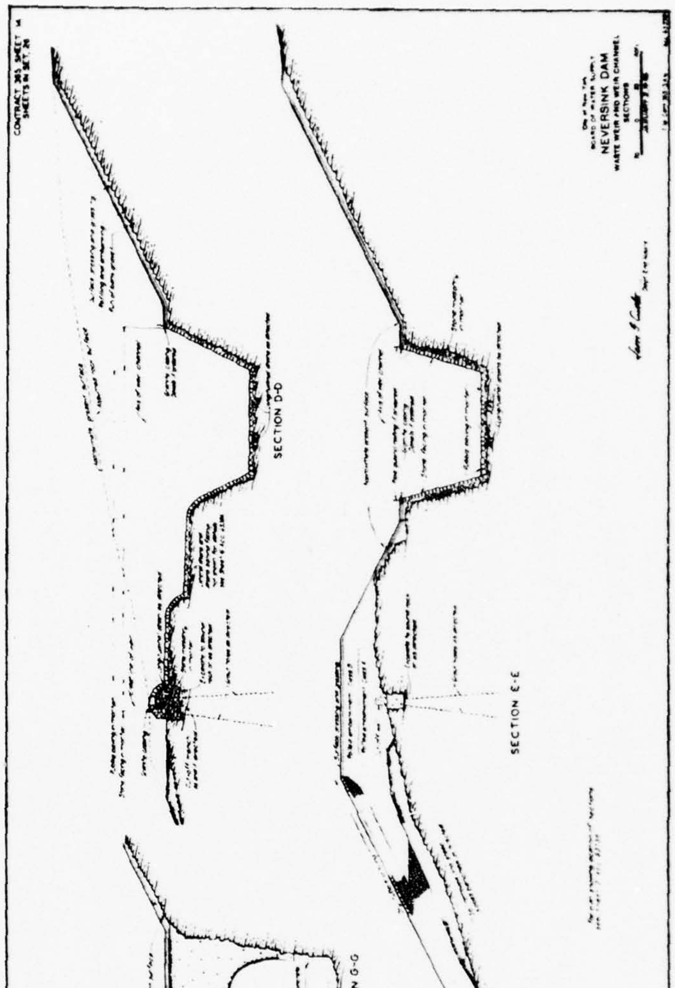

NEVERSINK DAM
SECTION D-D
SECTION E-E
SECTION G-G
SECTION C-C
SECTION F-F

FIGURE 15

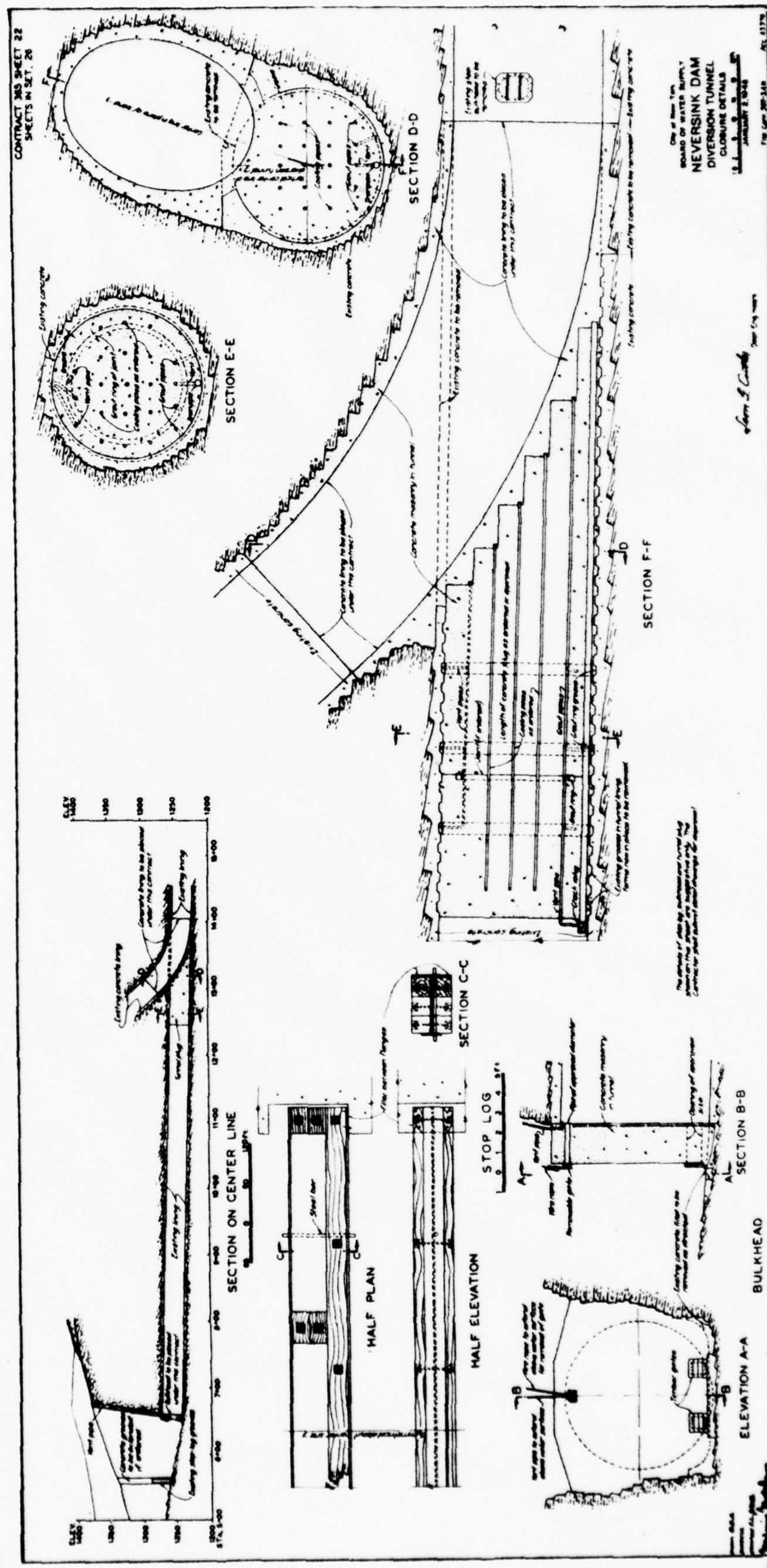

CONTRACT 383 SHEET 22
SHEETS IN SET 28
SECTION E-E
SECTION D-D
SECTION F-F
SECTION ON CENTER LINE
HALF PLAN
HALF ELEVATION
SECTION C-C
STOP LOG
SECTION B-B
ELEVATION A-A
BULKHEAD
NEVERSINK DAM
DIVERSION TUNNEL
CLOSURE DETAILS

FIGURE 16

APPENDIX A

FIELD INSPECTION REPORT

CHECK LIST
VISUAL INSPECTION

PHASE 1

Name Dam NEVERSINK DAM & RESERVOIR County SULLIVAN State NEW YORK ID # NY 348

Type of Dam EARTHEN Hazard Category HIGH

Date(s) Inspection JULY 21, 1978 Weather SUNNY Temperature 80^{0}

Pool Elevation at Time of Inspection 1429.22 M.S.L. Tailwater at Time of Inspection --

Inspection Personnel:

N. F. DUNLEVY	DALE ENGINEERING CO.	BEN MUSSO, SECTION ENGR. IN CHG. OF MAINT.
F. W. BYSZEWSKI	DALE ENGINEERING CO.	BOB BURNICK, ASSISTANT DIVISION ENGINEER
D. McCARTHEY	DALE ENGINEERING CO.	
B. COLWELL	DALE ENGINEERING CO.	

N. F. DUNLEVY Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	N/A	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N/A	
DRAINS	N/A	
WATER PASSAGES	N/A	
FOUNDATION	N/A	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL & HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	
STAFF GAGE OF RECORDER	N/A	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Some slight surface cracks. An estimated number of woodchuck holes were observed on the downstream face.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Slight sloughing areas around woodchuck holes noted. Believed to be created from animal holes	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Good.	
RIPRAP FAILURES	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No seepage noted nor erosion. Rock on west abutment shows some weathering.	
ANY NOTICEABLE SEEPAGE	None.	
STAFF GAGE AND RECORDER	None.	
DRAINS	All drains located were open; no flow.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Some surface spalling. Very minor leaking through joints in the masonry.	
APPROACH CHANNEL	Reservoir face.	
DISCHARGE CHANNEL	Some vegetative growth which should be removed from emergency spillway channel.	
BRIDGE AND PIERS	Good.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	None.	
APPROACH CHANNEL	None.	
DISCHARGE CHANNEL	None.	
BRIDGE AND PIERS	None.	
GATES AND OPERATION EQUIPMENT	None.	

OUTLET WORKS

NOT VISIBLE

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Surface spalling of approximately 1" on 20% of invert concrete panels. Two small areas have exposed the welded wire fabric reinforcement.	
INTAKE STRUCTURE		
OUTLET STRUCTURE		
OUTLET CHANNEL	Good.	
EMERGENCY GATE		

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Good; clear.	
SLOPES	Relatively flat.	
APPROXIMATE NO. OF HOMES AND POPULATION	Small community below dam.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	Monuments at top of dam; appear to be in place. Have not been surveyed in recent years.	
OBSERVATION WELLS	Yes, located at top of dam. Has not been inspected in years. Wells seem to be in place.	
WEIRS	None observed.	
PIEZOMETERS	None observed.	
OTHER	None.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Sloped areas are treed. No apparent potential for slides.	
SEDIMENTATION	Some erosion has taken place. Trees have been planted to correct problem.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE 1

NAME OF DAM Neversink

ID # NY 348

ITEM	REMARKS
AS-BUILT DRAWINGS	See N.Y.C. Board of Water Supply.
REGIONAL VICINITY MAP	See this report.
CONSTRUCTION HISTORY	See this report and N.Y.C. Board of Water Supply.
TYPICAL SECTIONS OF DAM	See this report.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	See this report.
RAINFALL/RESERVOIR RECORDS	U.S.G.S. Gage below dam at Neversink.

ITEM	REMARKS
DESIGN REPORTS	See N.Y.C. Board of Water Supply.
GEOLOGY REPORTS	See N.Y.C. Board of Water Supply.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	See N.Y.C. Board of Water Supply.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	See N.Y.C. Board of Water Supply.
POST-CONSTRUCTION SURVEYS OF DAM	See N.Y.C. Board of Water Supply.
BORROW SOURCES	See N.Y.C. Board of Water Supply.

ITEM	REMARKS
MONITORING SYSTEMS	None in use; available at site. Data with N.Y.C. Board of Water Supply.
MODIFICATIONS	None noted.
HIGH POOL RECORDS	Data not available.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	No data available.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None noted.
MAINTENANCE OPERATION RECORDS	See N.Y.C. Board of Water Supply.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	See this report and N.Y.C. Board of Water Supply.
OPERATING EQUIPMENT PLANS & DETAILS	See this report and N.Y.C. Board of Water Supply.

CHECK LIST
HYDROLOGIC & HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 90± sq. miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1440 ±

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): -

ELEVATION MAXIMUM DESIGN POOL: -

ELEVATION TOP DAM: 1460.0

CREST:

a. Elevation 1440
b. Type Concrete ogee weir into side channel trough into 30' dia. tunnel.
c. Width -
d. Length 600 feet
e. Location Spillover East Abutment
f. Number and Type of Gates None

OUTLET WORKS: (Drawdown)

a. Type Pipes regulated by broom gates
b. Location Intake house tunneled into outlet tunnel
c. Entrance Inverts -
d. Exit Inverts -
e. Emergency Draindown Facilities Peak capacity 115MGD, 19MGD at flow, 57MGD day of inspection for fish life consideration (hot day).

HYDROMETEOROLOGICAL GATES:

a. Type U.S.G.S. gauge at lower extremity of stilling basin area.
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: -

APPENDIX B

PREVIOUS INSPECTION REPORTS

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STATE O[illegible] YO[illegible]

DEPA[illegible]MENT O[illegible] [illegible]UBLIC W[illegible]

ALBA[illegible]Y

15, 1948 — Dam No. 162-1366

1, 1948 — Watershed [illegible] Delaware River

the Constructi[illegible] or Reconstruction of a Dam

[illegible]de to the Superintendent of Public Works, Albany, N. Y., in compliance with the [illegible] Conservation Law (see thi[illegible] page of this application) for the approval of specifica-

[illegible]marked Contract 365-1 [illegible]ersink Dam. Accs. 63414, 58435, 63375, [illegible], 55812, 55[illegible], [illegible], 63367, 6333[illegible], 6336[illegible], 6333[illegible], 633[illegible], [illegible], 633[illegible], 63398, [illegible]370, [illegible], 63391, 63365, 63358.

[illegible]onstruction / [illegible]construction of a dam h[illegible]rein described. All provisions of law will be complied [illegible]posed dam. It is intended to complete the work covered by the application about

[illegible]eversink River flowing into Delaware River in the

County of Sullivan

[illegible] from the Vill[illegible]e of [illegible]eversink.
[illegible]rection from a well-known bri[illegible], dam, village main cross-roads or mouth of a stream)

on the [illegible]eversi[illegible] quadrangle of the

Board of Water [illegible] of the City of New York.

1[illegible] [illegible]ll Str[illegible] New York, New York.

[illegible]blic water [illegible]

[illegible]ilt upon or its pond flood any State lands? no

[illegible]ed dam is [illegible] square miles

[illegible]ond area at the spillcrest elevation of 1,500 [illegible]

cubic feet of water.

B-1

9. The maximum height of the proposed dam above the bed of the stream is [illegible] feet [illegible] inches.

10. The lowest part of the natural shore of the pond is [illegible] feet vertically above the spillcrest, and everywhere else the shore will be at least [illegible] feet above the spillcrest.

11. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the proposed dam. Failure would cause [illegible] in the valley of the [illegible] River to and beyond [illegible]bourne, New York.

12. The natural material of the bed on which the proposed dam will rest is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.) Sandstone with interbedded shale and an overburden of glacial till, sand and gravel.

13. Facing downstream, what is the nature of material composing the right bank? Sandstone and a thin overburden of glacial till.

14. Facing downstream, what is the nature of the material composing the left bank? Sandstone with practically no overburden.

15. State the character of the bed and the banks in respect to the hardness, perviousness, water bearing, effect of exposure to air and to water, uniformity, etc. Ledge rock directly under the cut-off wall will be thoroughly grouted. The glacial till is quite impervious. The layers of sand and gravel are relatively pervious.

16. Are there any porous seams or fissures beneath the foundation of the proposed dam? All seams and fissures beneath the cut-off wall will be thoroughly grouted.

17. WASTES. The spillway of the above proposed dam will be [illegible] feet long in the clear; the waters will be held at the right end by a retaining [illegible] the top of which will be [illegible] feet above the spillcrest, and have a top width of 60 feet; and at the left end by a retaining [illegible] the top of which will be 20 feet above the spillcrest, and have a top width of [illegible] feet.

18. The spillway is designed to safely discharge [illegible] cubic feet per second.

19. Pipes, sluice gates, etc., for flood discharge will be provided through the dam as follows: [illegible] will be [illegible] through the [illegible] at [illegible] tunnel [illegible] provided [illegible] of the dam.

20. What is the maximum [illegible] of [illegible] which will [illegible] on the dam? [illegible]

21. [illegible] the proposed dam there will be [illegible] [illegible] feet [illegible]

22. [illegible] any [illegible] water supply? [illegible]

APPENDIX C

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

DALE

DESIGN BRIEF

DESIGNED BY JPG DATE 8-7-78

CHECKED BY PAGE C-1 OF

PROJECT NO. 2210 SHORT TITLE NY DAM INSPECTION

DESIGN SUBJECT NEVERSINK RESERVOIR DAM REF. DWGS.

ESTIMATE OF CLARK'S PARAMETERS

ESTIMATE OF TC (BPR)

$$T_C = (11.9\,L^3/H)^{.385} = (11.9\,(21.439)^3/1500)^{.385} = 5.35 \text{ HR}$$

SCS

$$L = \frac{l^{.8}\,(S+1)^{.7}}{1900\,Y^{.5}} = \frac{(113200)^{.8}\,(3.89+1)^{.7}}{1900\,(2.0)^{.5}} \qquad S = \frac{1000}{CN} - 10 = 3.89$$

$$= \frac{33542.339}{2687.01} = 12.483$$

$$T_C = L/.6 = 12.483/.6 = 20.805 \text{ HR}$$

NORTH ATLANTIC DIV WATER RESOURCES STUDY (FEB 72)

$$T_C + R = 10\,(a)\,(DA/S)^{.25}$$

$$= 10\,(1.03)\,(89.504/81)^{.25} = 10.56$$

$R/(T_C+R) = .30$ $\qquad T_C + R = 10.56$

$R/(10.56) = .30$ $\qquad T_C = 10.56 - 3.17 = 7.40$

$R = 3.168$

DALE

DESIGN BRIEF

DESIGNED BY N.F.D DATE 8.7.78

CHECKED BY PAGE C-2 OF

PROJECT NO. 2210 SHORT TITLE NY DAM INSPECTIONS

DESIGN SUBJECT NEVERSINK RESERVOIR DAM REF. DWGS.

ESTIMATE OF SNYDER PARAMETERS

640 C_P =
C_P = 0.625 assumed
C_T = 2.000 assumed

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$t_P = C_t (L \times L_{CA})^{0.3}$

$t_P = 2.0 (20 \times 8)$

$t_P = 4.9$

$t_r = t_P / 5.5 = 4.9/5.5 = 0.9$

$t_{pr} = t_p + .25 (t_R - t_r)$

$t_{pr} = 4.9 + .25 (2 - 0.9) = 5.2$

SUMMARY OF PARAMETERS

CLARK'S		SNYDER'S
BPR	Tc = 5.3	
SCS (CN METHOD)	Tc = 20.3	t_{pr} = 5.2
NORTH ATLANTIC DIV	Tc = 7.40	C_P = 0.625

$R/(T_c + R) = 0.30$

$R = 3.17$

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DALE

DESIGN BRIEF

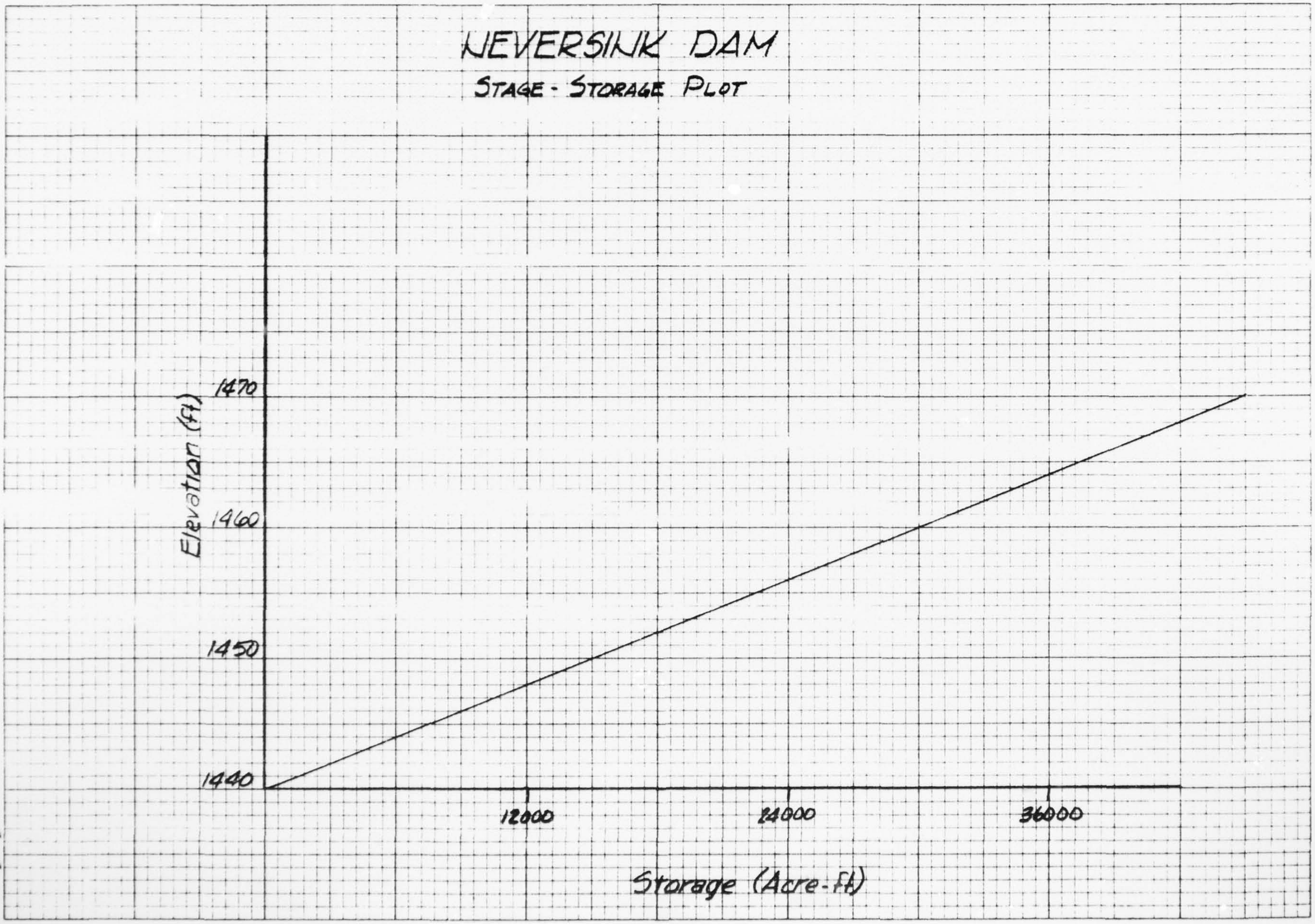
DESIGNED BY JPG | DATE 8.7.78
CHECKED BY | PAGE 6-3 OF
PROJECT NO. 2210 SHORT TITLE NY DAM INSPECTIONS
DESIGN SUBJECT NEVERSINK RESERVOIR DAM | REF. DWGS.

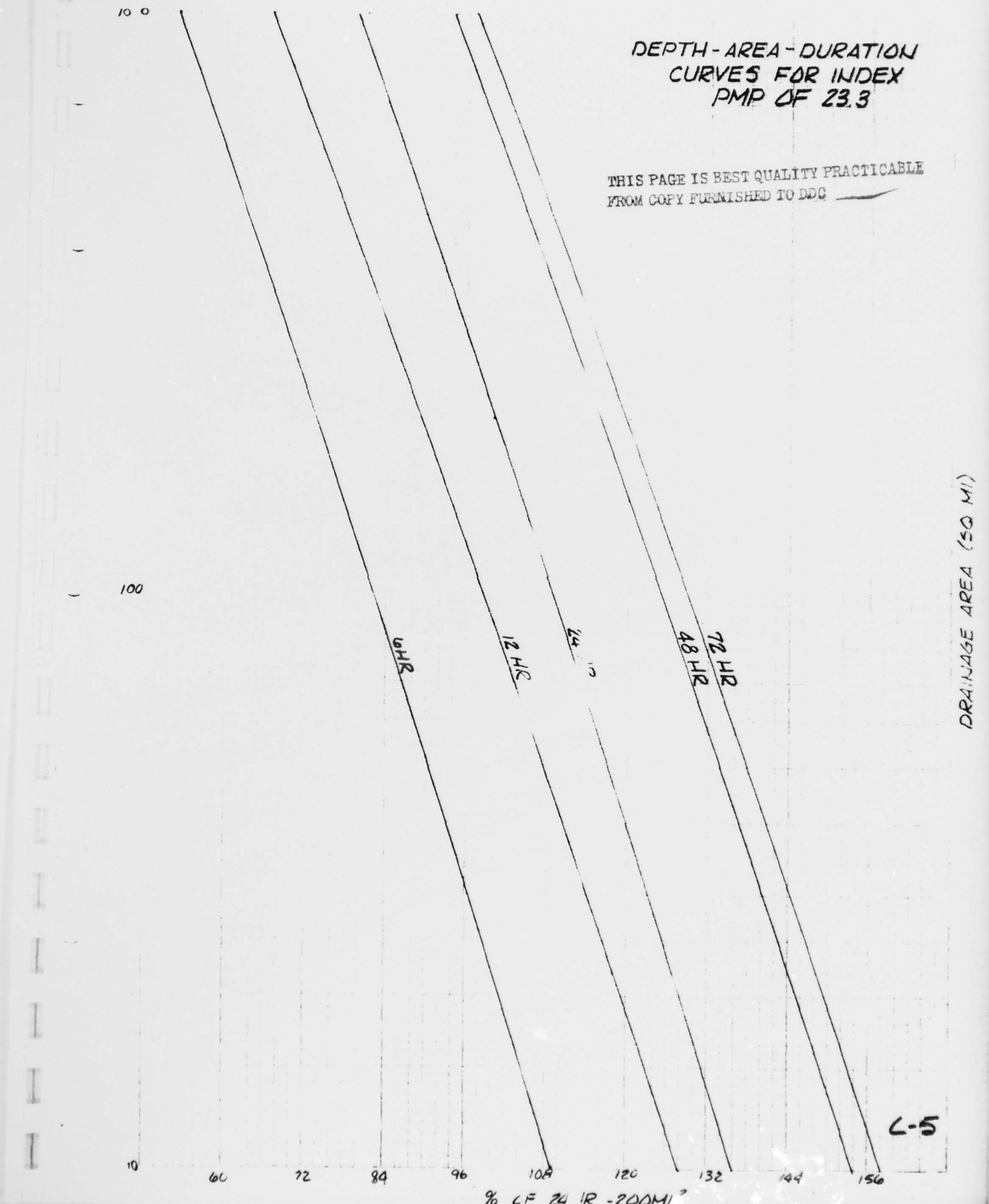
D-A-D RELATIONSHIPS **
** PMP HYDROMETEOROLOGICAL REPORT NO 51

AREA	DURATION	DEPTH	% OF INDEX
10 mi^2	6 Hr	25.5	109
10 mi^2	12 Hr	29.9	128
10 mi^2	24 Hr	31.8	136
10 mi^2	48 Hr	35.8	154
10 mi^2	72 Hr	36.8	158
200 mi^2	6 Hr	17.1	73
200 mi^2	12 Hr	20.5	88
* 200 mi^2	24 Hr	23.3	100
200 mi^2	48 Hr	27.0	116
200 mi^2	72 Hr	28.0	120
1000 mi^2	6 Hr	12.3	53
1000 mi^2	12 Hr	15.5	67
1000 mi^2	24 Hr	18.[illegible]	81
1000 mi^2	48 Hr	22.[illegible]	94
1000 mi^2	72 Hr	22.5	97

* PMP INDEX RAINFALL - 24 HR DURATION
200 MI^2

DURATION	% OF INDEX
6 HR	83.7
12 HR	100.0
24 HR	110.3
48 HR	126.5
72 HR	131.3


NEVERSINK DAM
STAGE - STORAGE PLOT
Elevation (ft)
1470
1460
1450
1440
12000
24000
36000
Storage (Acre-Ft)



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STETSON • DALE BANKERS TRUST BUILDING UTICA • NEW YORK • 13501 TEL 315•797•5800 **DESIGN BRIEF**

PROJECT NAME NY DAM INSPECTION DATE 8.24.78

SUBJECT FLOOD OF RECORD PROJECT NO. 2210

DRAWN BY HFD

NOVEMBER 25, 1950

RAINFALL AT PRATTSVILLE 3.66 INCHES TOTAL

TRACE OF POSITION OF SIGNIFICANT RAINFALL

0.09	0.19
0.10	0.33
0.17	0.31
0.16	0.42
0.12	0.77
0.19	0.97
0.19	0.52
0.23	7 PERIODS - 2 HR EACH
0.38	
0.39	
0.53	
0.44	
0.43	
0.09	
14 PERIODS - 1 HR EACH	

```
SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      1
ENTER TIME INTERVAL(MIN)=  120.

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      2
ENTER DRAINAGE AREA (SQMI) =     89.50
SELECT 1-3 (1=INPUT UH, 2=CLARK, 3=SNYDER )       2
ENTER NUMBER OF TIME-AREA ORDINATES (0=NONE)=     0
ENTER CLARKS TC AND R (HRS) =        7.40      3.20

       TP       CP       TC       R

    5.62   0.691    7.40    3.20

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      3
ENTER RATIO  IMPERVIOUS =         0.00
SELECT 1-3 ( 1=RAIN, 2=SPS, 3=PMS )       1
ENTER NUMBER PERIODS OF RAIN =       7
ENTER RAINFALL (IN/TIME INT) =
      0.19      0.33      0.31      0.47      0.77      0.97      0.52
ENTER STORM TOTAL (0=SUM OF RAIN) (IN) =             3.66
SELECT 1-3 (1=INIT+CONST, 2=ACUM LOSS, 3=SCS)        1
ENTER INITIAL LOSS(IN), CONSTANT LOSS(IN/HR) =       1.00      0.10

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      4
ENTER A TITLE PLEASE -    NEVERSINK NOV.55
ENTER STRTQ,QRCSN,AND RTIOR =      189.00  189.00    1.00
```

HR	MIN	RAIN	LOSS	EXCESS	UNIT HG	RECSN	FLOW
2	0	0.20	0.20	0.00	1366.	189.	189.
4	0	0.34	0.34	0.00	4561.	189.	189.
6	0	0.32	0.32	0.00	7096.	189.	189.
8	0	0.44	0.28	0.16	6744.	189.	407.
10	0	0.80	0.20	0.60	4333.	189.	1738.
12	0	1.01	0.20	0.81	2270.	189.	5167.
14	0	0.54	0.20	0.34	1189.	189.	9685.
16	0				623.	189.	12228.
18	0				327.	189.	11027.
20	0				171.	189.	7544.
22	0				90.	189.	4314.
24	0				47.	189.	2350.
26	0					189.	1321.
28	0					189.	783.
30	0					189.	500.
32	0					189.	349.
34	0					189.	258.
36	0					189.	205.
TOTAL		3.65	1.74	1.91	28818.	3402.	58444.

```
SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      1
ENTER TIME INTERVAL(MIN)=  120.

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      2
ENTER DRAINAGE AREA (SQMI) =      89.50
SELECT 1-3 (1=INPUT UH, 2=CLARK, 3=SNYDER )         3
ENTER SNYDERS CP AND TP (HRS) =           0.62       5.20
ENTER INITIAL EST. CLARKS TO & (HRS) (0=DEFAULT)=  0.00       0.00

      TP        CP        TC        R

     4.44     0.561     6.10     3.74
     5.09     0.662     6.23     3.96
     5.25     0.655     6.23     4.15
     5.28     0.644     6.14     4.27
     5.26     0.636     6.07     4.34
     5.24     0.630     6.07     4.34

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      3
ENTER RATIO  IMPERVIOUS =          0.00
SELECT 1-3 ( 1=RAIN, 2=SPS, 3=PMS )       1
ENTER NUMBER PERIODS OF RAIN =      7
ENTER RAINFALL (IN/TIME INT) =
      0.19       0.33       0.31       0.42       0.77       0.97       0.52
ENTER STORM TOTAL (0=SUM OF RAIN) (IN  =              3.66
SELECT 1-3 (1=INIT+CONST, 2=ACUM LOSS  3=SCS)         1
ENTER INITIAL LOSS(IN), CONSTANT LOSS IN/HR) =        1.00       0.10

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      4
ENTER A TITLE PLEASE -   NEVERSINK NO .55
ENTER STRTQ,QRCSN,AND RTIOR =      189.00  189.00     1.00

 HR MIN  RAIN  LOSS EXCESS  UNIT HG    RECSN    FLOW
  2   0  0.20  0.20  0.00    1446.     189.     189.
  4   0  0.34  0.34  0.00    4788.     189.     189.
  6   0  0.32  0.32  0.00    6943.     189.     189.
  8   0  0.44  0.28  0.16    5863.     189.     420.
 10   0  0.80  0.20  0.60    3678.     189.    1823.
 12   0  1.01  0.20  0.81    2301.     189.    5344.
 14   0  0.54  0.20  0.34    1440.     189.    9663.
 16   0                       901.     189.   11547.
 18   0                       564.     189.    9873.
 20   0                       353.     189.    6772.
 22   0                       221.     189.    4312.
 24   0                       139.     189.    2769.
 26   0                        87.     189.    1804.
 28   0                        55.     189.    1200.
 30   0                                189.     822.
 32   0                                189.     585.
 34   0                                189.     437.
 36   0                                189.     339.
 38   0                                189.     263.
 40   0                                189.     208.

TOTAL      3.65  1.74  1.91   28780.    3780.   58749.
```

```
SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)        1
ENTER TIME INTERVAL(MIN)=  180.


SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)        2
ENTER DRAINAGE AREA (SQMI) =      89.50
SELECT 1-3 (1=INPUT UH, 2=CLARK, 3=SNYDER )         2
ENTER NUMBER OF TIME-AREA ORDINATES (0=NONE)=       0
ENTER CLARKS TC AND R (HRS) =          7.40        3.20

        TP        CP        TC        R

      5.47     0.591      7.40      3.20


SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)        3
ENTER RATIO  IMPERVIOUS =           0.00
SELECT 1-3 ( 1=RAIN, 2=SPS, 3=PMS )          2
ENTER SPS INDEX RAINFALL (IN) = 11.70
ENTER TRSFC AND TRSDA (SQMI) =             1.00      89.50
SELECT 1-3 (1=INIT+CONST, 2=ACUM LOSS, 3=SCS)       1
ENTER INITIAL LOSS(IN), CONSTANT LOSS(IN/HR) =       1.00        0.10


SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)        4
ENTER A TITLE PLEASE -   NEVERSINK SPF
ENTER STRTQ,QRCSN,AND RTIOR =       189.00   189.00      1.00
```

HR	MIN	RAIN	LOSS	EXCESS	UNIT HG	RECSN	FLOW
3	0	0.01	0.01	0.00	2242.	189.	189.
6	0	0.01	0.01	0.00	6238.	189.	189.
9	0	0.03	0.03	0.00	6156.	189.	189.
12	0	0.03	0.03	0.00	2942.	189.	189.
15	0	0.10	0.10	0.00	1064.	189.	189.
18	0	0.20	0.20	0.00	385.	189.	189.
21	0	0.02	0.02	0.00	140.	189.	189.
24	0	0.02	0.02	0.00	51.	189.	189.
27	0	0.04	0.04	0.00		189.	189.
30	0	0.04	0.04	0.00		189.	189.
33	0	0.12	0.12	0.00		189.	189.
36	0	0.12	0.12	0.00		189.	189.
39	0	0.44	0.38	0.06		189.	324.
42	0	0.89	0.30	0.59		189.	1886.
45	0	0.07	0.07	0.00		189.	4239.
48	0	0.07	0.07	0.00		189.	3998.
51	0	0.31	0.30	0.01		189.	2011.
54	0	0.31	0.30	0.01		189.	925.
57	0	0.85	0.30	0.55		189.	1782.
60	0	0.85	0.30	0.55		189.	5029.
63	0	3.08	0.30	2.78		189.	13308.
66	0	6.26	0.30	5.96		189.	35910.
69	0	0.52	0.30	0.22		189.	57182.
72	0	0.52	0.30	0.22		189.	47721.
75	0	0.02	0.02	0.00		189.	23696.
78	0	0.02	0.02	0.00		189.	9710.
81	0	0.05	0.05	0.00		189.	3783.
84	0	0.05	0.05	0.00		189.	1482.
87	0	0.17	0.17	0.00		189.	608.
90	0	0.35	0.30	0.05		189.	343.
93	0	0.03	0.03	0.00		189.	512.
96	0	0.03	0.03	0.00		189.	497.

99	0					189.	336.
102	0					189.	242.
105	0					189.	208.
108	0					189.	196.
111	0					189.	192.
114	0					189.	189.
117	0					189.	189.
TOTAL		15.63	4.63	11.00	19217.	7371.	218763.

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP) 1
ENTER TIME INTERVAL(MIN)= 180.

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP) 2
ENTER DRAINAGE AREA (SQMI) = 89.50
SELECT 1-3 (1=INPUT UH, 2=CLARK, 3=SNYDER) 3
ENTER SNYDERS CP AND TP (HRS) = 0.62 5.20
ENTER INITIAL EST. CLARKS TC & R (HRS) (0=DEFAULT)= 0.00 0.00

TP	CP	TC	R
4.82	0.548	5.61	3.65
4.88	0.583	5.98	3.40
4.97	0.606	6.25	3.30
5.05	0.613	6.43	3.24
5.11	0.615	6.55	3.19
5.14	0.616	6.62	3.14
5.16	0.618	6.62	3.10
5.15	0.620	6.69	3.10
5.17	0.618	6.69	3.07
5.16	0.621	6.69	3.07

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP) 3
ENTER RATIO IMPERVIOUS = 0.00
SELECT 1-3 (1=RAIN, 2=SPS, 3=PMS) 2
ENTER SPS INDEX RAINFALL (IN) = 11.70
ENTER TRSPC AND TRSDA (SQMI) = 1.00 89.50
SELECT 1-3 (1=INIT+CONST, 2=ACUM LOSS 3=SCS) 1
ENTER INITIAL LOSS(IN), CONSTANT LOSS(IN/HR) = 1.00 0.10

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP) 4
ENTER A TITLE PLEASE - NEVERSINK SP
ENTER STRTQ,QRCSN,AND RTIOR = 189.00 189.00 1.00

HR	MIN	RAIN	LOSS	EXCESS	UNIT HG	RECSN	FLOW
3	0	0.01	0.01	0.00	2679.	189.	189.
6	0	0.01	0.01	0.00	6937.	189.	189.
9	0	0.03	0.03	0.00	6020.	189.	189.
12	0	0.03	0.03	0.00	2368.	189.	189.
15	0	0.10	0.10	0.00	814.	189.	189.
18	0	0.20	0.20	0.00	280.	189.	189.
21	0	0.02	0.02	0.00	97.	189.	189.
24	0	0.02	0.02	0.00	34.	189.	189.
27	0	0.04	0.04	0.00		189.	189.
30	0	0.04	0.04	0.00		189.	189.
33	0	0.12	0.12	0.00		189.	189.
36	0	0.12	0.12	0.00		189.	189.
39	0	0.44	0.38	0.06		189.	350.
42	0	0.89	0.30	0.59		189.	2186.
45	0	0.07	0.07	0.00		189.	4643.
48	0	0.07	0.07	0.00		189.	3883.
51	0	0.31	0.30	0.01		189.	1662.
54	0	0.31	0.30	0.01		189.	782.
57	0	0.85	0.30	0.55		189.	1963.
60	0	0.85	0.30	0.55		189.	5621.

63	0	3.08	0.30	2.78		189.	14815.
66	0	6.26	0.30	5.96		189.	40066.
69	0	0.52	0.30	0.22		189.	60616.
72	0	0.52	0.30	0.22		189.	45372.
75	0	0.02	0.02	0.00		189.	19622.
78	0	0.02	0.02	0.00		189.	7736.
81	0	0.05	0.05	0.00		189.	2845.
84	0	0.05	0.05	0.00		189.	1098.
87	0	0.17	0.17	0.00		189.	472.
90	0	0.35	0.30	0.05		189.	352.
93	0	0.03	0.03	0.00		189.	543.
96	0	0.03	0.03	0.00		189.	490.
99	0					189.	307.
102	0					189.	230.
105	0					189.	203.
108	0					189.	194.
111	0					189.	191.
114	0					189.	189.
117	0					189.	189.
TOTAL		15.63	4.63	11.00	19229.	7371.	218886.

```
UNIT GRAPH AND HYDROGRAPH COMP JULY 1966 (REVISED AUGUST 1974)
HYDROLOGIC ENGINEERING CENTER (HEC)
DAVIS,CA


--- OPERATIONS AVAILABLE ---

TIME INT = SET TIME INTERVAL OF ALL COMPUTATIONS
UNIT H   = COMPUTE UH BY INPUT, CLARK, OR SNYDER
RAIN     = INPUT RAIN AND LOSS RATE DATA
RUNOFF   = INPUT BASEFLOW, COMPUTE & PRINT HYDROGRAPH
PNT      = PRINT UNIT HYDROGRAPH ONLY
STOP     = STOP EXECUTION OF PROGRAM

USER MUST SELECT OPERATION DESIRED
MAY RETURN TO ANY OPERATION


SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      1
ENTER TIME INTERVAL(MIN)=  180.


SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      2
ENTER DRAINAGE AREA (SQMI) =     89.50
SELECT 1-3 (1=INPUT UH, 2=CLARK, 3=SNYDER )        2
ENTER NUMBER OF TIME-AREA ORDINATES (0=NONE)=      0
ENTER CLARKS TC AND R (HRS) =         7.40       3.20

      TP        CP       TC        R

    5.47    0.[illegible]1     7.40     3.20


SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      3
ENTER RATIO IMPERVIOUS =        0.00
SELECT 1-3 ( 1=RAIN, 2=SPS, 3=PMS )       3
ENTER PMS INDEX RAINFALL (IN) = 23.30
ENTER R6,R12,R24,R48,R72,R96 =       83.70  100.00  110.30  126.50  131.30    [illegible].0
ENTER TRSFC AND TRSDA (SQMI) =            0.00      89.50
SELECT 1-3 (1=INIT+CONST, 2=ACUM LOSS, 3=SCS)       1
ENTER INITIAL LOSS(IN), CONSTANT LOSS(IN/HR) =      1.00       0.10
```

```
SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)          4
ENTER A TITLE PLEASE -  NEVERSINK PMF
ENTER STRTQ,QRCSN,AND RTIOR =        189.00  189.00      1.00
```

HR	MIN	RAIN	LOSS	EXCESS	UNIT HG	RECSN	FLOW
3	0	0.06	0.06	0.00	2242.	189.	189.
6	0	0.06	0.06	0.00	6236.	189.	189.
9	0	0.24	0.24	0.00	6156.	189.	189.
12	0	0.24	0.24	0.00	2942.	189.	189.
15	0	0.82	0.55	0.27	1064.	189.	794.
18	0	1.66	0.30	1.36	385.	189.	4922.
21	0	0.09	0.09	0.00	140.	189.	10335.
24	0	0.09	0.09	0.00	51.	189.	9355.
27	0	0.41	0.30	0.11		189.	4724.
30	0	0.41	0.30	0.11		189.	2673.
33	0	1.64	0.30	1.34		189.	5118.
36	0	1.64	0.30	1.34		189.	12756.
39	0	5.56	0.30	5.26		189.	29099.
42	0	11.29	0.30	10.99		189.	69988.
45	0	0.62	0.30	0.32		189.	107267.
48	0	0.62	0.30	0.32		189.	87993.
51	0	0.02	0.02	0.00		189.	42791.
54	0	0.02	0.02	0.00		189.	17079.
57	0	0.07	0.07	0.00		189.	6508.
60	0	0.07	0.07	0.00		189.	2455.
63	0	0.24	0.24	0.00		189.	916.
66	0	0.49	0.30	0.19		189.	676.
69	0	0.03	0.03	0.00		189.	1390.
72	0	0.03	0.03	0.00		189.	1359.
75	0					189.	748.
78	0					189.	391.
81	0					189.	262.
84	0					189.	216.
87	0					189.	199.
90	0					189.	189.
93	0					189.	189.
TOTAL		26.42	4.81	21.61	19217.	5859.	421147.

```
SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      1
ENTER TIME INTERVAL(MIN)=  180.

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      2
ENTER DRAINAGE AREA (SQMI) =      89.50
SELECT 1-3 (1=INPUT UH, 2=CLARK, 3=SNYDER )          3
ENTER SNYDERS CP AND TP (HRS) =           0.62        5.20
ENTER INITIAL EST. CLARKS TO & (HRS) (0=DEFAULT)=  0.00        0.00

       TP        CP        TC        R

     4.82     0.548      5.61      3.65
     4.88     0.583      5.98      3.40
     4.97     0.606      6.25      3.30
     5.05     0.613      6.43      3.24
     5.11     0.615      6.55      3.19
     5.14     0.616      6.62      3.14
     5.16     0.616      6.62      3.10
     5.15     0.620      6.69      3.10
     5.17     0.618      6.69      3.07
     5.16     0.621      6.69      3.07

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      3
ENTER RATIO  IMPERVIOUS =          0.00
SELECT 1-3 ( 1=RAIN, 2=SPS, 3=PMS )          3
ENTER PMS INDEX RAINFALL (IN) = 23.30
ENTER R6,R12,R24,R48,R72,R96 =       83.70   100.00   110.30   126.50   131.30     0.0
ENTER TRSPC AND TRSDA (SQMI) =              0.00        89.50
SELECT 1-3 (1=INIT+CONST, 2=ACUM LOSS, 3=SCS)         1
ENTER INITIAL LOSS(IN), CONSTANT LOSS(IN/HR) =        1.00        0.10

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      4
ENTER A TITLE PLEASE -  NEVERSINK PMF
ENTER STRTQ,QRCSN,AND RTIOR =        189.00   189.00       1.00

 HR MIN   RAIN  LOSS EXCESS   UNIT HG    RECS      FLOW
  3   0   0.06  0.06  0.00     2679.      189.      189.
  6   0   0.06  0.06  0.00     6937.      189.      189.
  9   0   0.24  0.24  0.00     6020.      189.      189.
```

12	0	0.24	0.24	0.00	2368.	189.	189.
15	0	0.82	0.55	0.27	814.	189.	912.
18	0	1.66	0.30	1.36	280.	189.	5705.
21	0	0.09	0.09	0.00	97.	189.	11249.
24	0	0.09	0.09	0.00	34.	189.	9016.
27	0	0.41	0.30	0.11		189.	3924.
30	0	0.41	0.30	0.11		189.	2429.
33	0	1.64	0.30	1.34		189.	5611.
36	0	1.64	0.30	1.34		189.	14138.
39	0	5.56	0.30	5.26		189.	32039.
42	0	11.29	0.30	10.99		189.	77481.
45	0	0.62	0.30	0.32		189.	113261.
48	0	0.62	0.30	0.32		189.	83365.
51	0	0.02	0.02	0.00		189.	35148.
54	0	0.02	0.02	0.00		189.	13467.
57	0	0.07	0.07	0.00		189.	4838.
60	0	0.07	0.07	0.00		189.	1777.
63	0	0.24	0.24	0.00		189.	678.
66	0	0.49	0.30	0.19		189.	740.
69	0	0.03	0.03	0.00		189.	1518.
72	0	0.03	0.03	0.00		189.	1333.
75	0					189.	639.
78	0					189.	344.
81	0					189.	242.
84	0					189.	207.
87	0					189.	195.
90	0					189.	189.
93	0					189.	189.
TOTAL		26.42	4.81	21.61	19229.	5859.	421390.

DALE

DESIGN BRIEF

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PROJECT NO. 2210

SHORT TITLE NEVERSINK - SPILLWAY CALCULATIONS

DESIGN SUBJECT

DATE 8/78

PAGE L-17 OF

REF. DWGS.

TABLE OF CONTENTS

DALE

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DESIGNED BY AMS DATE 8/78
CHECKED BY PAGE C-18 OF
PROJECT NO. 2210 SHORT TITLE NEVERSINK - LAKE ELEV VS SPILLWAY FLOWS
DESIGN SUBJECT REF. DWGS.

SUMMARY

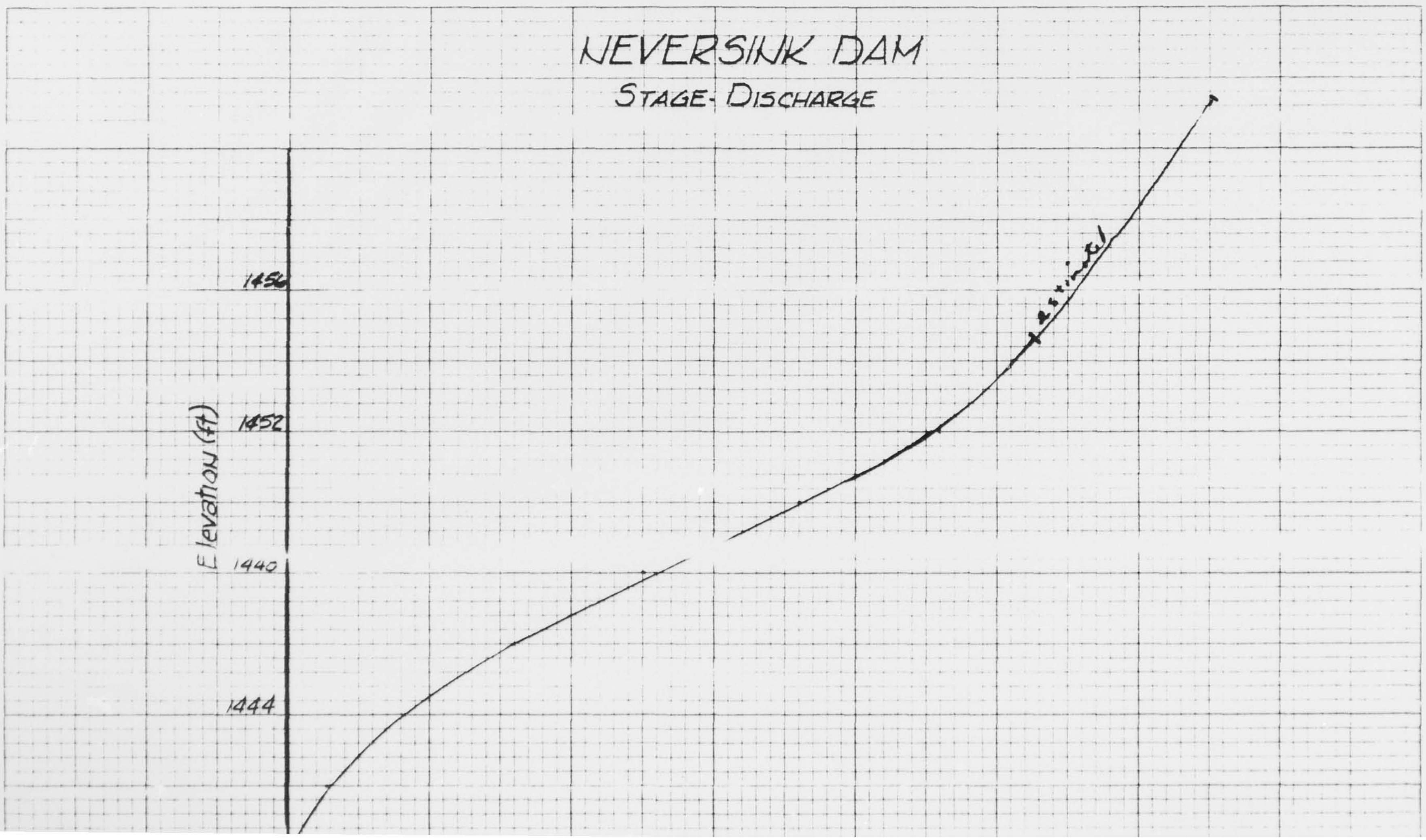
LAKE ELEV.	SPILLWAY FLOW
1440 (ft)	0
	1950 cfs
1442	5,620
	10,500
1444	16,500
	23,400
1446	31,200
	40,100
1448	50,000
	60,800
1450	72,100
	83,200
1452	91,900
	98,900
1454	102,100

WEIR CONTROL w/ FREE DISCHARGE

WEIR CONTROL w/ SUBMERGENCE

PMF ≈ 100,000 cfs

- see text of calculations for additional values


NEVERSINK DAM
STAGE-DISCHARGE
estimated
Elevation (ft)
1456
1452
1440
1444

DALE

DESIGN BRIEF

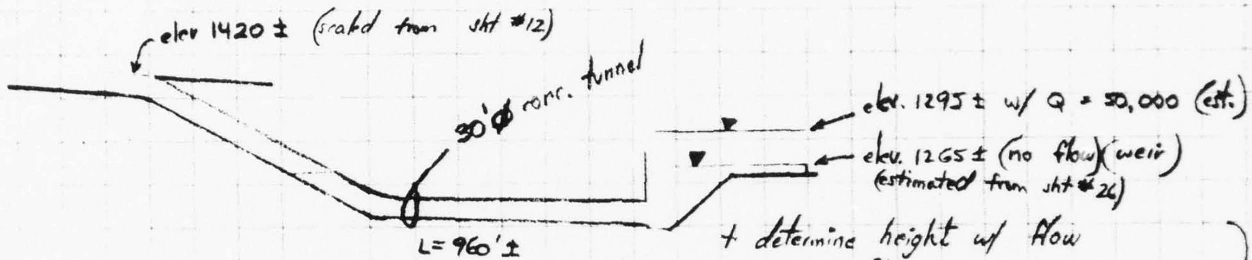
DESIGNED BY AMS DATE 8/8/78

CHECKED BY PAGE 6-20 OF 4

PROJECT NO. 2210 SHORT TITLE NEVERSINK - DIVERSION TUNNEL FLOW CALC.

DESIGN SUBJECT REF. DWGS.

object - determine max. flow in tunnel spillway & no flow in waste channel



+ determine height of flow

$Q = CLh^{3/2} = 50{,}000$ cfs assumed

$4.0 \times 170 \times h^{3/2} = 50{,}000$

$h = 18'$ (will be submerged)

let $h = 30'$

head available = head lost

elevation change = entrance loss + velocity head + fitting losses + pipe loss

$$\Delta h = k_{en}\frac{V^2}{2g} + \frac{V^2}{2g} + \Sigma k_i \frac{V^2}{2g} + f\frac{L}{D}\frac{V^2}{2g}$$

$$1420 - 1295' = \left[.10 + 1.0 + .2 + .02\,\frac{960}{30}\right]\frac{V^2}{2 \times 32.2}$$

L = 960' ±

f = Darcy - Weisbach coefficient

from .001 to .005 - smooth concrete form

" .005 to .02 - rough " "

use f = .02 (conservative)

$$125' = 1.94\,\frac{V^2}{64.4}$$

$V = 64.4$ fps (wow)

$Q = VA = 64.4$ ft/sec $\times \frac{30'}{4} = \boxed{45{,}500 \text{ cfs} = Q_{max}}$

DALE

DESIGN BRIEF

DESIGNED BY ____ DATE 8-9-78

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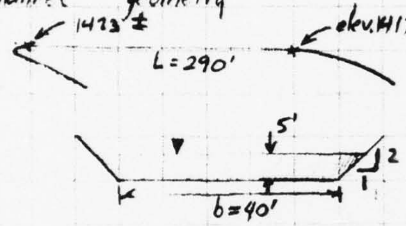
PROJECT NO. 2210 SHORT TITLE NEVERSINK - WASTE CHANNEL CALC.

DESIGN SUBJECT ____ REF. DWGS. ____

$\boxed{\text{object}}$ - determine outflow (total) for 5' depth in waste channel.

waste channel geometry



$s = \frac{6'}{290'} = .0207 \approx .020$

$a = 5' \times \frac{40 + 45}{2} = 217.5$ sq ft

$p = 40 + 2 \cdot (5.6) = 51.2'$

$r = \frac{a}{p} = \frac{217.5}{51.2} = 4.15'$

n = .035 rock - riprap - rubble.

$V = \frac{1.49}{n} r^{2/3} s^{1/2} = \frac{1.49 \times 4.15^{2/3} \times .02)^{1/2}}{.035} = \frac{1.49 \times 2.58 \times .14}{.035} =$

$= 15.4$ fps

$Q_{wc} = VA = 15.4 \text{ fps} \times 217.5 \text{ ft}^2 = 3,300$ cfs

$\Delta h = \Sigma k \frac{V^2}{2g}$

$11.8' = 1.94 \, V^2/2g$

$V = 65.1 \quad \therefore Q_{tunnel} = 46,100$

$\boxed{49,400 \text{ cfs}}$

DALE

DESIGN BRIEF

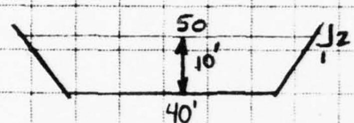
DESIGNED BY ______ DATE ______

CHECKED BY ______ PAGE 6-22 OF 8

PROJECT NO. ______ SHORT TITLE NEVERSINK - WASTE CHANNEL CALC

DESIGN SUBJECT ______ REF. DWGS. ______

$\boxed{\text{objective}}$ - determine outflow for 10' depth flow in waste channel



$a = 45' \times 10' = 450\ ft^2$

$p = 40 + 2 \cdot (11.2) = 62.4$

$r = a/p = 450/62.4 = 7.21' \quad \therefore r^{2/3} = 3.73$

$n = .035$

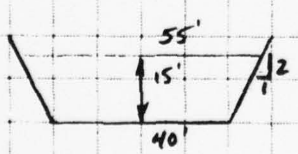
$V = \frac{1.49}{n} \cdot r^{2/3} \cdot s^{1/2} = \frac{1.49 \times 3.7 \times .141}{.035} = 22.4\ fps$

$Q_{wc} = VA = 22.4\ fps \times 450\ ft^2 = 10,100\ cfs$

$132 = 1.94\ V^2/64.4 \Rightarrow V = 66.2 \therefore Q_{tunnel} = \underline{46,800\ cfs}$

$Q_{TOT} = \boxed{56,900\ cfs}$

$\boxed{\text{objective}}$ - determine Q_T for 15' in waste channel



$a = 47\tfrac{1}{2} \times 15' = 712.5\ ft^2$

$p = 40 + 2(16.8) = 67.2\ ft$

$r = a/p = 712.5/67.2 = 10.6 \quad r^{2/3} = 4.83$

$n = .035 \quad s^{1/2} = .141$

$V = \frac{1.49}{n} r^{2/3} s^{1/2} = 1.49 \times 4.83 \times .141/.035 = 29.0\ fps$

$Q_{wc} = VA = 29.0\ fps \times 712.5\ ft^2 = 20,400\ cfs$

$137 = 1.94\ V^2/64.4 \therefore V = 67.4 \therefore Q = \underline{47,700\ cfs}$

$\boxed{Q_T = 67,100\ cfs}$

DALE

DESIGN BRIEF

DESIGNED BY ______ DATE ______

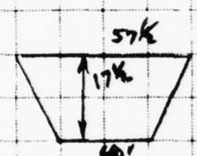
CHECKED BY ______ PAGE 6-23 OF ______

PROJECT NO. ______ SHORT TITLE ______

DESIGN SUBJECT ______ REF. DWGS. ______

note to self ; with flow of 17' ± in waste channel, the water surface elev. will be 1423 ± + 17' ± ≅ 1440' which is equal to the crest of the weir (1440)
⇒ weir will be submerged for flows in waste channel > 17' ±

OBJECT determine total outflow for 17½' depth in waste channel



$a = 17\tfrac{1}{2}' \times \left(\frac{57\tfrac{1}{2} + 40}{2}\right) = 853.$

$p = 40 + 2\,(19.6) = 79.2$

$r = a/p = 853/79.2 = 10.77 \qquad r^{2/3} = 4.87$

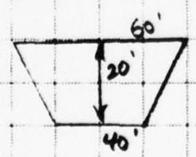
$V = \frac{1.49}{n} r^{2/3} s^{1/2} = \frac{1.49}{.085} \times 4.87 \times .141 = 29.3$ fps

$Q = VA = 29.3$ fps $\times 853.$ ft² $= 25{,}000$ cfs.

$138 = \frac{1.94}{64.4} V^2, \quad v = 67.6 \quad \therefore Q_{TUN} = 47{,}800$ cfs

$\boxed{Q_{TOT} = 72{,}800 \text{ cfs}}$

OBJECT determine total outflow for 20' depth in waste channel



$a = 50' \times 20' = 1000\ ft^2$

$p = 40 + 2\,(22.4) = 84.8'$

$r = a/p = 1000/84.8 = 11.8' \qquad r^{2/3} = 5.2$

$V = \frac{1.49}{n} r^{2/3} s^{1/2} = \frac{1.49}{.035} \times 5.2 \times .141 = 31.1$

$Q = VA = 31.1$ fps $\quad 1000$ ft² $= 31{,}100$

$Q_T \approx 47{,}900$

$\boxed{Q_{TOT} = 79{,}000 \text{ cfs}}$

DALE

DESIGN BRIEF

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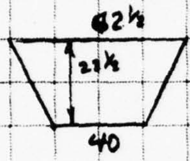
PROJECT NO. ____________ SHORT TITLE ____________

DESIGN SUBJECT ____________ REF. DWGS. ____________

OBJECTIVE – determine total outflow for 22½' depth in waste channel



$a = 51\tfrac{1}{4}' \times 22\tfrac{1}{2}' = 1153.\ ft^2$

$p = 40 + 2\ (25.2) = 90.4'$

$r = a/p = 1153/90.4 = 12.7 \qquad r^{2/3} = 5.45$

$V = \frac{1.49}{n} r^{2/3} s^{1/2} = \frac{1.49}{.035} \times 5.45 \times .141 = 32.8$

$Q = VA = 32.8\ fps \times 1153\ sf = 37,800.\ cfs$

$Q_{TUN} = \underline{48,000\ cfs}$

$\boxed{Q_{TOT} = 85,800\ cfs}$

OBJECTIVE – determine total outflow for 25' depth flow in waste channel

$a = 52\tfrac{1}{2} \times 25 = 1312\ sf$

$p = 40 + 2\ (28.) = 96'$

$r = a/p = 1312/96 = 13.7' \qquad r^{2/3} = 5.7$

$V = \frac{1.49}{n} r^{2/3} s^{1/2} = \frac{1.49}{.035} \times 5.7 \times .141 = 34.3$

$Q = VA = 34.3\ fps \times 1312\ s.f. = 45,000\ cfs$

$Q_{TUN} \doteq \underline{48,100\ cfs}$

$\boxed{Q_{TOT} = 93,100\ cfs}$

DALE

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PROJECT NO. SHORT TITLE
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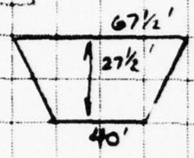
PAGE 6-25 OF

REF. DWGS.

OBJECTIVE determine total outflow for 27½' depth of flow in waste channel.



$a = 53\tfrac{3}{4} \times 27\tfrac{1}{2} = 1478$ sf

$p = 40 + 2(30.8) = 101.6'$

$r = 1478 \text{ sf} / 101.6 = 14.5 \qquad r^{2/3} = 6.0$

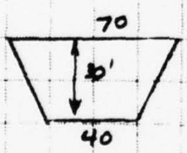
$V = \frac{1.49}{n} r^{2/3} s^{1/2} = \frac{1.49}{.035} \times 6.0 \times .141 = 35.8$

$Q = VA = 35.8 \text{ fps} \times 1478 \text{ sf} = 52{,}900$ cfs

$Q_{TUN} \cong 48{,}200$ cfs

$\boxed{Q_{TOT} = 101{,}100 \text{ cfs}}$

OBJECTIVE determine total outflow for 30' depth flow in waste channel



$a = 55' \times 30' = 1650$ sf

$p = 40 + 2(33.6) = 107.2'$

$r = 1650 \text{ sf} / 107.2 = 15.4 \qquad r^{2/3} = 6.2$

$V = \frac{1.49}{n} r^{2/3} s^{1/2} \qquad \frac{1.49}{.035} \times 6.2 \times .141 = 37.1$ fps

$Q = VA = 37.1 \text{ fps} \times 1650 \text{ sf} = 61{,}300$ cfs

$Q_{TUN} \cong 48{,}300$ cfs

$\boxed{Q_{TOT} = 109{,}600 \text{ cfs}}$

DALE

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DESIGN BRIEF

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PROJECT NO. 2210 SHORT TITLE NEVERSINK - SPILLWAY WEIR CALCULATIONS

DESIGN SUBJECT

REF. DWGS.

Spillway Sections. The typical overflow spillway section of a dam, as illustrated in Fig. 5-26, is a weir with rounded crest. The coefficient varies from 3.0 to more than 4.0, depending primarily on the shape of the crest, the extent of end contraction, and the head. Because of the variation in C for different weirs, it is necessary to calibrate each weir if a high degree of accuracy is desired. However, the shape of the crest is often designed as a "standard crest," which was developed to fit the shape of the under-

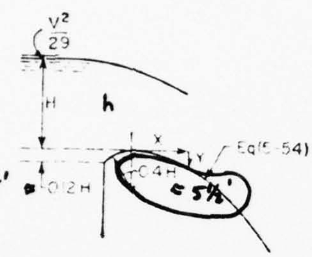
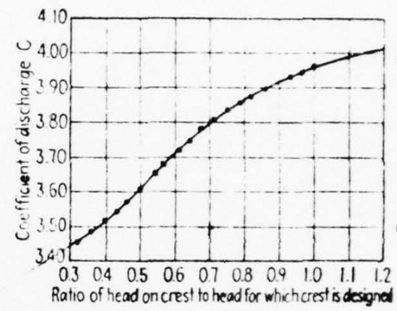


FIG. 5-26. Spillway section "standard crest."

← "Handbook of Hydraulics" by King & Brater, 5th Ed, pg 5-28



← "Handbook of Applied Hydraulics" Davis pg 1225

$.4\,H = 5.5'$

$\therefore H = 13.75' \approx 14'$ = height for which spillway crest designed

$L = 600'$

ELEVATION	h	h/H	C	$Q = CLh^{3/2}$ (cfs)
1440	0	—	—	0
	1	.07	3.[illegible] ±	1950
	2	.14	3.[illegible] ±	5620
	3	.21	3.[illegible] ±	10,500
		.25	3.[illegible] ±	13,400
	4	.29	3.43 ±	16,500
		.32	3.46	19,800
1445	5	.36	3.49	23,400
		.39	3.[illegible]1	27,200
	6	.43	3.[illegible]4	31,200
		.46	3.[illegible]7	35,500
	7	.50	3.[illegible]1	40,100
		.54	3.[illegible]5	45,000
	8	.57	3.[illegible]3	50,000
		.61	3.[illegible]2	55,300
	9	.64	3.[illegible]5	60,800
		.68	3.[illegible]8	66,400
1450	10	.71	3.[illegible]3	72,100

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PROJECT NO. 2210 SHORT TITLE NEVERSINK - SPILLWAY WEIR CALCULATIONS

DESIGN SUBJECT REF. DWGS.

(CON'T)

ELEVATION	h	h/H	C	$Q = CLh^{3/2}$ (cfs)
1450½	10½	.75	3.83	78,200
1451	11	.79	3.86	~~84,500~~
		.82	3.88	~~90,800~~
1452	12	.86	3.90	~~97,300~~
		.89	3.91	~~103,700~~
1453	13	.93	3.93	~~110,500~~
		.96	3.94	~~117,300~~
1454	14	1.00	3.96	~~124,500~~

weir affected by submergence.
=> revise figures

WEIR FLOWS REVISED FOR SUBMERGENCE

ELEV.	H	Q	Assumed % Reduction in Q Due to Submergence	$Q' = (1-\%) \times Q$
1451	11	84,500	1.5	83,200
	11½	90,800	3.5	87,600
1452	12	97,300	5.5	91,900
	12½	103,700	8.	95,400
1453	13	110,500	10.5	98,900
	13½	117,300	14	100,900
1454	14	124,500	18	102,100

DALE

DESIGN BRIEF

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PROJECT NO. ______ SHORT TITLE NEVERSINK - INVESTIGATION OF WEIR SUBMERGENCE

DESIGN SUBJECT ______ REF. DWGS. ______

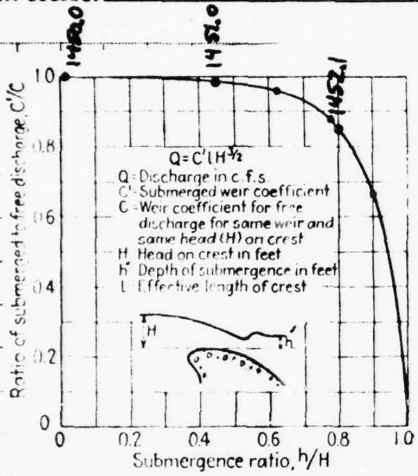
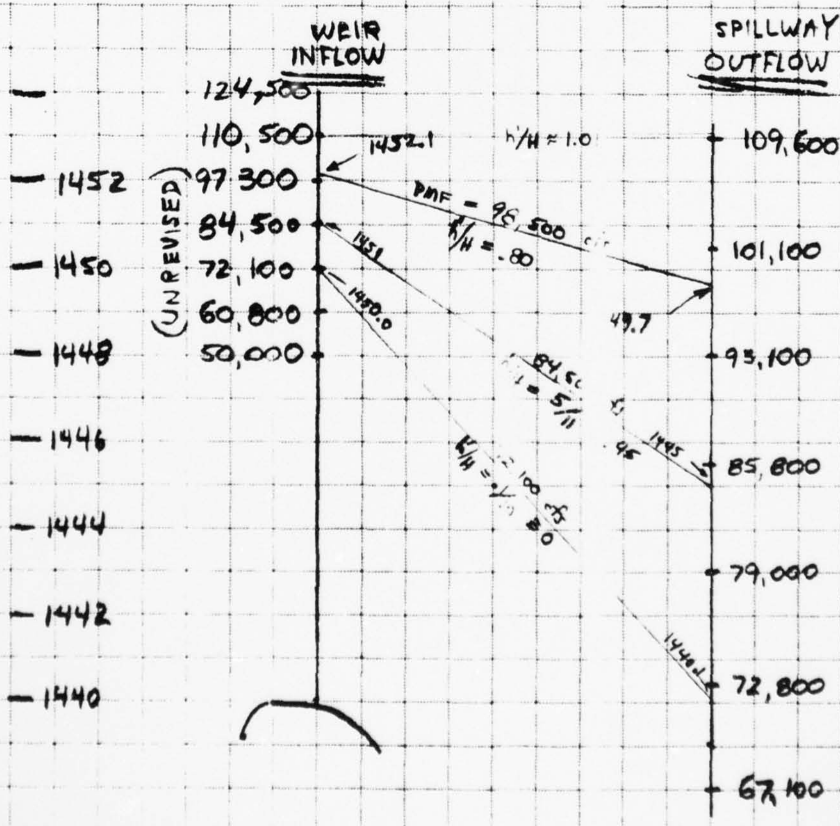


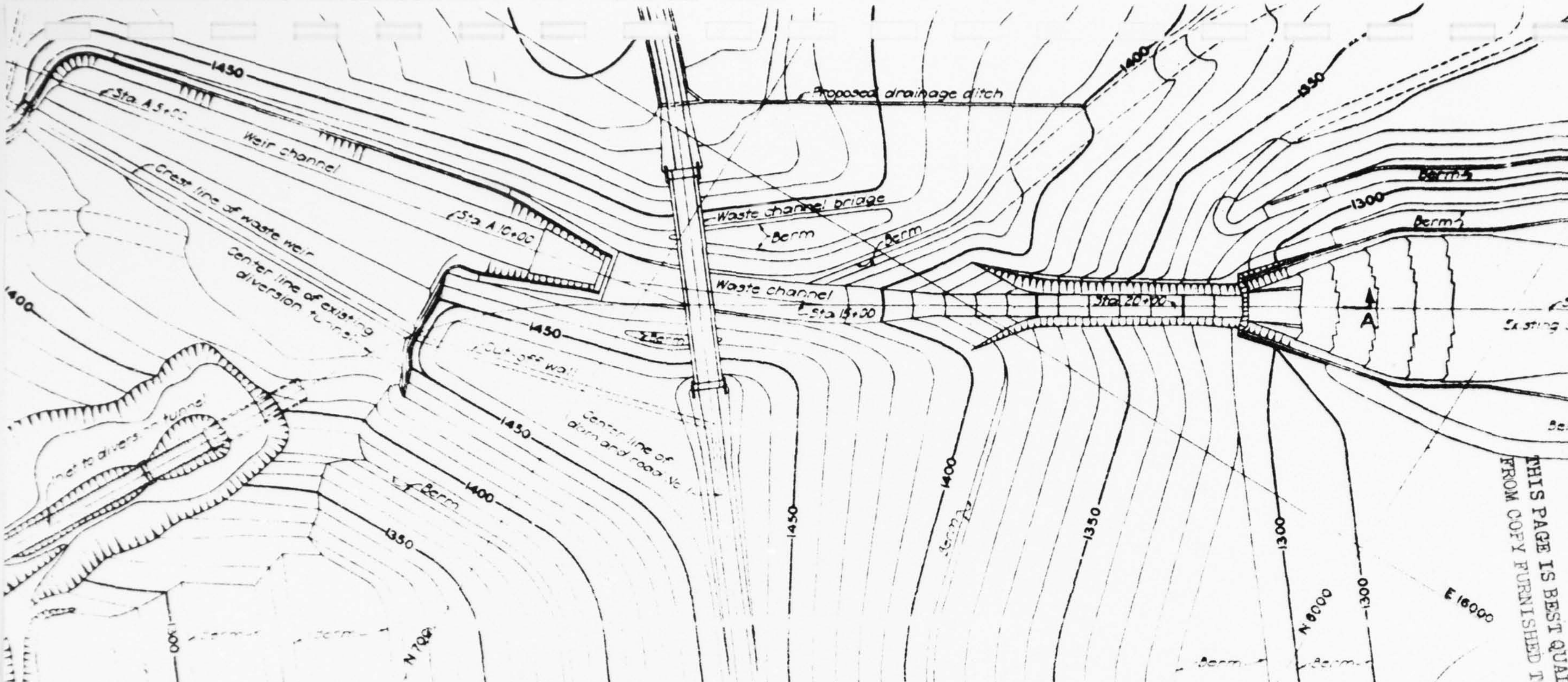
FIG. 25.— Submerged discharge curve.



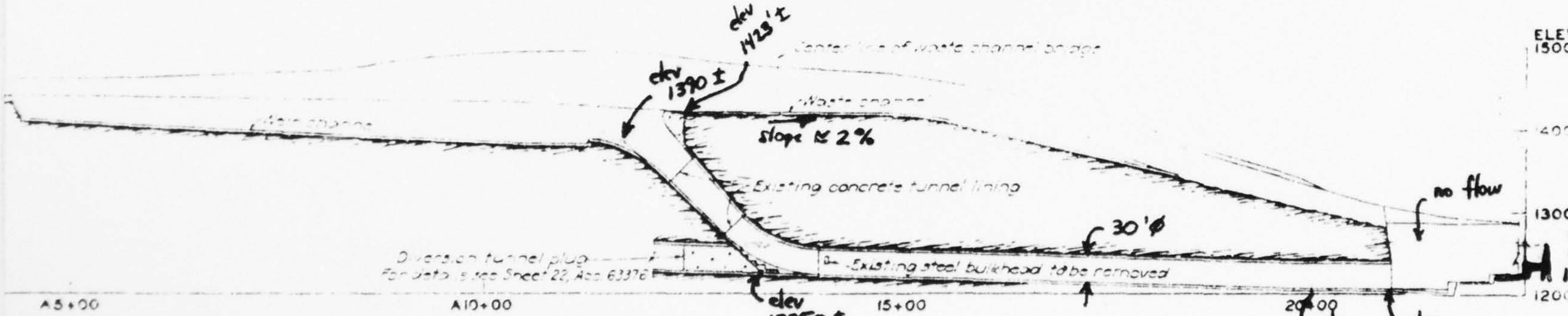
H = 12.1 h' = 9.7

$h'/H = 9.7/12.1 = .80$

★ => weir discharge will be affected by submergence for flows ≥ ≈ 84,500 cfs => revise calculations.



PLAN



SECTION A-A

For detail topography, waste weir and channels see Sheet 10, Acc 63366
For plan and section of waste weir and weir channel see Sheet 12, Acc 63338
For plan and section of waste channel see Sheet 3, Acc 63364

Leon G. Cutler
Dept Eng Hdqrs

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City of New
BOARD OF WATE

NEVERSIN

WASTE WEIR AND
GENERAL PLAN A

100 0

JANUARY 2,

File Cont 38

C-9

```
00100 A NEVERSINK DAM
0110 A RESERVOIR ROUTING OVER STRUCTURE OF PMF
0120 A SPILLWAY CONTROL
0130 B     27       3
0140 1      3
0150 K      0
0160 M     -1               89
0170 N    189     912     5705   11249    9016   39[illegible]4    2429    5611   14138   32039
0180 N  77481  113261    83365   35148   13467   48[illegible]8    1777     678     740    1518
0190 N   1333     639      344     242     207   1[illegible]5     189
0200 K      1
0210 Y                                1
0220 1      1                                                -1
0230 2      0    1500     3000    4500    6000   90[illegible]0   12000   15000   18000   21000
0240 3      0    1950     5620   10500   23400   312[illegible]0  50000   72100   98900  102100
0250 K     99
0260 A
0270 A
0280 A
```

```
00100 A NEVERSINK DAM
0110 A RESERVOIR ROUTING OVER STRUCTURE OF SPF
0120 A SPILLWAY CONTROL
0130 B     27       3
0140 1      3
0150 K      0
0160 M     -1               89
0170 N    189     350     2186    4643    3883   166[illegible]     782    1963    5621   14815
0180 N  40066   60616    45372   19622    7736   284[illegible]    1098     472     352     543
0190 N    490     307      230     203     194   19[illegible]     189
0200 K      1
0210 Y                                1
0220 1      1                                                -1
0230 2      0    1500     3000    4500    6000   900[illegible]   12000   15000   18000   21000
0240 3      0    1950     5620   10500   23400    3120   50000   72100   98900  102100
0250 K     99
0260 A
0270 A
0280 A
```

NEVERSINK DAM
RESERVOIR ROUTING OVER STRUCTURE OF SPF
SPILLWAY CONTROL

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
27	3	0	0	0	0	0	0	0	0

JOPER	NWT
3	0

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
0	0	0	0	0	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
-1	0	89.00	0.0	0.0	0.0	0.0	0	0	0

INPUT HYDROGRAPH

189.	350.	2186.	4643.	3883.	1662.	782.	1963.	5621.	14815.
40066.	60616.	45372.	19622.	7736.	2845.	1098.	472.	352.	543.
490.	307.	230.	203.	194.	191.	189.			

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	60616.	52994.	245[illegible]7.	9002.	216620.
INCHES		5.54	10.[illegible]8	11.29	11.32
AC-FT		26292.	487[illegible].	53594.	53735.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
0	1	0	0	0	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	-1.

STORAGE#	0.	1500.	3000.	4500.	6000.	9000.	12000.	15000.	18000.	21000.
OUTFLOW#	0.	1950.	5620.	10500.	23400.	31200.	50000.	72100.	98900.	102100.

TIME	EOP STOR	AVG IN	EOP OUT
1	145.	189.	189.
2	163.	270.	211.
3	388.	1268.	505.
4	1010.	3415.	1312.
5	1624.	4263.	2254.
6	1723.	2773.	2495.
7	1478.	1222.	1922.
8	1361.	1373.	1769.
9	1761.	3792.	2588.
10	3197.	10218.	6262.
11	6245.	27441.	24036.
12	10620.	50341.	41352.
13	12227.	52994.	51673.
14	9569.	32497.	34765.
15	5879.	13679.	22359.
16	3515.	5291.	7294.
17	2542.	1972.	4498.
18	1835.	785.	2770.
19	1373.	412.	1784.
20	1087.	448.	1413.
21	896.	517.	1164.
22	732.	399.	952.
23	586.	269.	762.
24	470.	217.	611.
25	382.	199.	496.
26	317.	193.	412.
27	269.	190.	350.
SUM			216200.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	51673.	46512.	24030.	8977.	216200.
INCHES		4.86	10.05	11.26	11.30
AC-FT		23076.	47687.	53445.	53631.

********** ********** ********** ********** **********

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	[illegible]
HYDROGRAPH AT	0	60616.	52994.	24587.	[illegible]	[illegible]
ROUTED TO	0	51673.	46512.	24030.	[illegible]	[illegible]

AD-A064 141 NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/2
NATIONAL DAM SAFETY PROGRAM. NEVERSINK RESERVOIR DAM, (348), DE--ETC(U)
SEP 78 J B STETSON DACW51-78-C-0035

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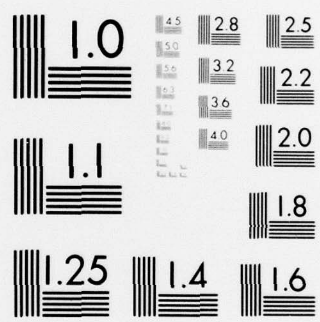

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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NEVERSINK DAM
RESERVOIR ROUTING OVER STRUCTURE OF PMF
SPILLWAY CONTROL

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
27	3	0	0	0	0	0	0	0	0

JOPER	NWT
3	0

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
0	0	0	0	0	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
-1	0	89.00	0.0	0.0	0.0	0.0	0	0	0

INPUT HYDROGRAPH

189.	912.	5705.	11249.	9016.	924.	2429.	5611.	14138.	32039.
77481.	113261.	83365.	35148.	13467.	838.	1777.	678.	740.	1518.
1333.	639.	344.	242.	207.	195.	189.			

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	113261.	98313.	46814.	17503.	420634.
INCHES		10.28	19.57	21.95	21.98
AC-FT		48775.	92902.	104201.	104343.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
0	1	0	0	0	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	-1.

STORAGE=	0.	1500.	3000.	4500.	6000.	9000.	12000.	15000.	18000.	21000.
OUTFLOW=	0.	1950.	5620.	10500.	23400.	31200.	50000.	72100.	98900.	102100.

TIME	EOP STOR	AVG IN	EOP OUT
1	145.	189.	189.
2	223.	551.	289.
3	867.	3309.	1127.
4	2334.	8477.	3991.
5	3467.	10133.	7139.
6	3349.	6470.	6754.
7	2695.	3177.	4873.
8	2532.	4020.	4476.
9	3520.	9875.	7310.
10	5727.	23089.	21056.
11	11153.	54766	44695.

12	17525.	95371.	94653.
13	17955.	98313.	98500.
14	13170.	59257.	58617.
15	8291.	24308.	29356.
16	5042.	9153.	15158.
17	3204.	3308.	6283.
18	2258.	1228.	3804.
19	1669.	709.	2363.
20	1426.	1129	1854.
21	1335.	1426.	1735.
22	1175.	986.	1527.
23	954.	492.	1240.
24	751.	293.	977.
25	591.	225.	768.
26	470.	201.	611.
27	380.	192.	494.
SUM			419839.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	98500.	96576.	46168.	17453.	419839.
INCHES		10.09	19.30	21.89	21.94
AC-FT		47914.	91620.	103905.	104146.

********** ********** ********** ********** **********

RUNOFF SUMMARY, AVER E FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	0	113261.	98313.	46814.	17503.	89.00
ROUTED TO	0	98500.	96576.	46168.	17453.	89.00

APPENDIX D

REFERENCES

APPENDIX D

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APPENDIX E

ATTACHMENTS

INFORMATION LEAFLET
N. Y. STATE CONSERVATION DEPT.
DIVISION OF CONSERVATION EDUCATION

This material from the
Department's official magazine —
THE N. Y. STATE CONSERVATIONIST

WOODCHUCK

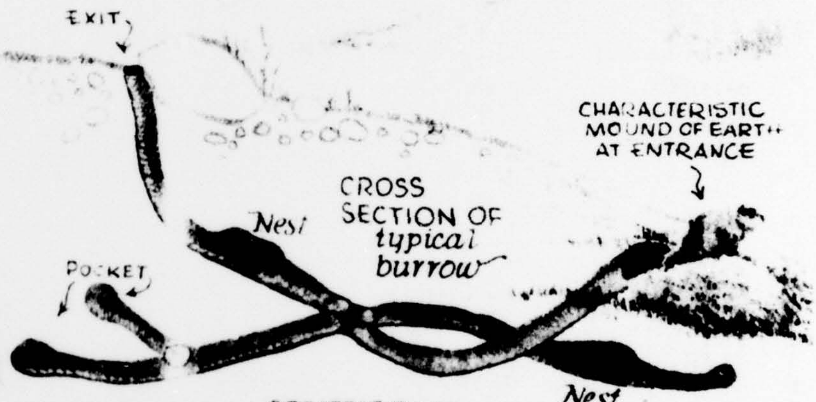
THE INSIDE ON THE OUTDOORS

By Clayt Seagears

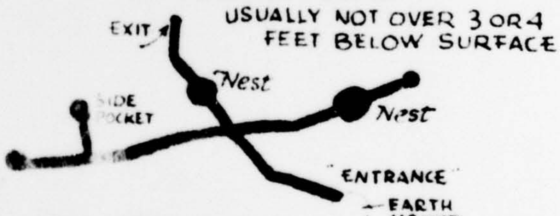
Top Wildlife Landlord is the WOODCHUCK

Its burrow is the original air conditioned unit which provides life saving shelter for countless cottontails which under certain conditions cant survive either extreme Summer heat or Winter cold.

An old chuck is among the most wary of all mammals--- and one of the best fighters



CROSS SECTION OF typical burrow



PLAN FROM ABOVE OF SAME BURROW. Tunnels often have sharper turns than shown and several exits

The woodchuck hibernates for about 25 weeks. Then its body heat is about that of the air around it. If the air freezes and the torpid chuck fails to heed Nature's danger signal and wake up, its body freezes too and our hero kicks the bucket. But there's little danger for the woodchuck's sub-soil nest probably never hits 32°

Wildlife Landlord

THE woodchuck is a much better little pal than most folks think he is—provided his home is located where he can't pack his paunch with produce. On a truck farm he's as welcome as a June frost and within his 100-yard operating radius he's just about as destructive. But a woodchuck on wasteland is a cherubic beast specializing in hotel management and with a university degree as an air conditioning engineer. However, if our friend was college bred, it must have been a four-year loaf—for there are few lazier animals.

In the excavating department, the woodchuck has dug up all sorts of honors which not only put him ahead of the field but under it.

They make homes for cottontails

For its average 10-pound size, the chunky 'chuck is our most abundant animal. His numbers, however, have been whittled to the point of virtual elimination by persistent small-bore hunters.

All this is well and good on agricultural lands. But when the woodchuck is removed from non-crop areas, the cottontail rabbit and such furbearers as the skunk also suffer.

The American cottontail, unlike his continental counterpart, digs no burrow. Nature muffed that one, for this most popular of all game animals apparently is not able to survive high summer heat unless cool retreat is available. Neither can the bunny survive a combination of zero weather and wind. Here's where the woodchuck hole enters. So does the rabbit. Moreover, the 'chuck's burrow provides handy refuge from many rabbit enemies.

Woodchucks have a common blueprint for their subsoil chalets. Normally, the main entrance, or plunge hole, is identified by a generous mound of earth. On this the grizzled proprietors while away the mid-day hours, scratching, stretching and scanning a surprising amount of horizon.

Usually there are one or more other entrances. No telltale earthworks mark these and often as not they're well concealed. These not only serve as escape holes but also it is possible they are deliberate ventilators in the woodchuck's air conditioning plan. The passageways normally change course at abrupt angles here and there and terminate in grass-lined nests the size of a bushel basket. Most burrows are dug less than four feet below the surface.

Woodchucks are not clannish people. A pair may occupy a burrow but most of the year one old whistle pig seems to be the sole proprietor. The young, normally five, are born in April, hit the deck in early June and are kicked out of house and home in late summer to set up their own diggings.

The 'chuck never feeds for long without snapping upright to take a gander for enemies. His eyes are plenty sharp and an old 'chuck is one of the most difficult to approach of all animals. What's more, a full grown 'chuck has few enemies except man, for they are fierce and determined fighters and never know when they're licked. Young 'chucks, however, are persistently hunted by many predators. Owls seldom get a crack at them because chucks limit their activities to daylight, unusual among animals.

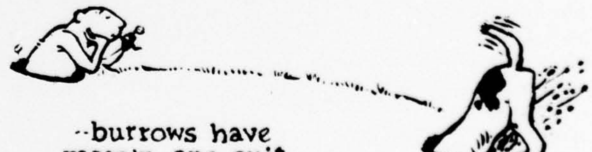
By late September or early October, woodchucks are very fat. Then's the time they call it a season and go underground until early spring. They are true hibernators in that when torpid their body temperature approximates that of the air around them. If that air should hit the freezing point, the woodchuck could be expected to freeze, too. However, studies of hibernation have shown that when that point is reached a chemical reaction in the animal's body apparently serves as a kind of alarm clock and the critter wakes up. Then the body temperature rises to normal until danger is passed. It is unlikely, however, that the woodchuck's nest ever approaches the freezing mark. It seems to hold a constant temperature of around 40° to 50° all winter.

When hibernating, the 'chuck is curled in a tight ball and its respirations may be slowed to one every four or five minutes. After about 5½ months of this sort of thing, the woodchuck feels some subtle urge to get going. Out he comes, often as not when there's still snow on the ground. Meantime, of course, he has had to come out anyway February 2 for a preliminary survey of the shadow department and to give off a few newspaper interviews. Everybody knows that. But otherwise his torpor is uninterrupted for nearly half the year. His fat serves him well as a backlog to maintain the low spark of life. If he should be dug up during hibernation, the process of waking is slow. The 'chuck staggers around as though all four legs were asleep—which they were. But after 15 or 20 minutes he is as lively as ever. Put him back down a hole and he's soon out cold again.

The woodchuck poses a complex management problem. Unquestionably he has no place on agricultural lands. But when he lives on abandoned farms, in the woodlot or on brushlands, that's something else again.

There's no question but that his burrow is a lifesaver for millions of cottontails. That immediately should tag him as the rabbit hunter's best friend. Also, that burrow is a boon to the rural boy trapper who annually harvests an estimated million dollars worth of fur in New York. A large part of that fur harvest is skunk. Ask any boy where he sets his traps.

On the other hand, the woodchuck is an important source of sport for an increasing army of small-bore enthusiasts who find in him worthy tests of marksmanship and stalking ability. For the most part, however, our hero has little chance against a combination of a good 'scope and a high velocity cartridge. Persistent woodchuck hunting already has cleaned out large sections of the countryside. Unfortunately, a lot of 'chuck hunting is done in spring when a bullseye on an old female means taps for her roly-poly young in the nest. And the hunter thus kills off his future sport.



--burrows have more'n one exit--

Increasing, also, is the use of the so-called gas bomb for woodchuck elimination. Intelligently used, the gassing method undoubtedly is the best for necessary control work. But it should only be used when 'chucks are an actual threat to agriculture. It should be remembered that gas is non-selective. There's little question but that hundreds of thousands of cottontails and valuable furbearers have been thoughtlessly destroyed by its indiscriminate use.

A young woodchuck is good to eat. All of them provide food for thought.

—CLAYT SEAGEARS